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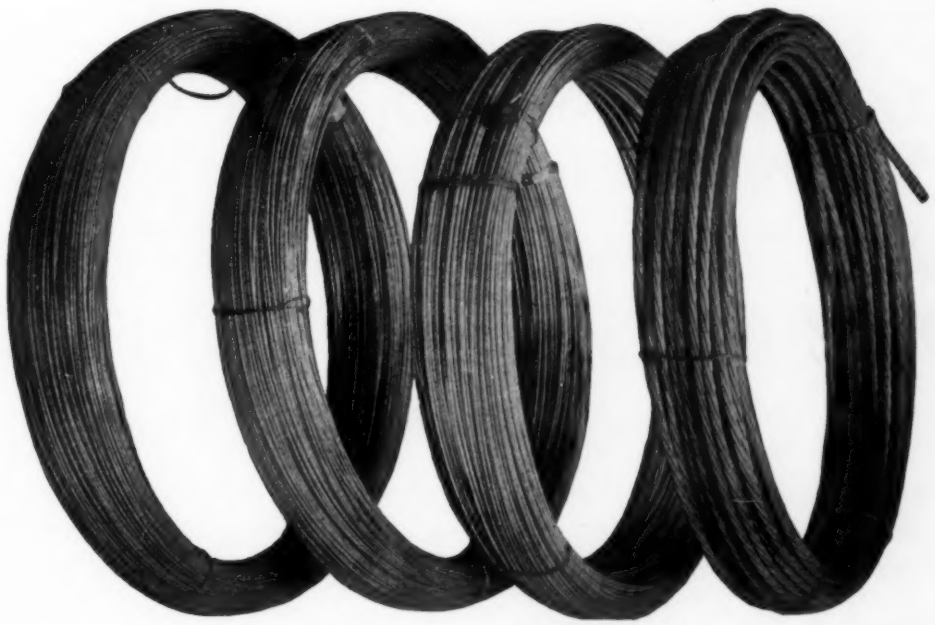

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Telephone Engineer

Volume 32 JULY, 1928 No. 7

The Danger From Reaction

A year or two ago, a certain telephone property was sold to a group of promoters. These promoters formed a holding company and sold preferred stock in amount almost equal to the purchase price and a considerable amount of no-par common stock, most of which was placed in the territory served by the company. After several months operation, during which an indebtedness of several thousand dollars was incurred, upon the action of a stockholder, the holding company was thrown into the hands of a receiver.

A few days ago, the assets of the holding company were offered for sale by the sheriff of the county in which it operates and were bid in at a price about fifteen per cent below the original purchase price. The amount of the bid after court costs and indebtedness is paid, was such that preferred stockholders will be fortunate if they realize fifty cents on the dollar of original investment.

It may be argued that this is an isolated case of failure due to one of two possible causes, incompetence or dishonesty of the promoters. Whatever may have been the cause, the effect upon the people of the community is exactly what repeatedly has been predicted in these columns; they have lost their confidence in telephone securities. If anyone thinks telephone securities can be sold in the territory operated by this company, let him try.

What has happened here on a small scale may happen on a larger scale in the case of some of the promotions that have been made fail to meet expectations and default their interest charges. Half a dozen large failures would give the telephone security market a set back that would require years for recovery.

Telephone associations and public service commissions are to be commended in their efforts to prevent unsound security issues being sold to the public and it is to be hoped that their efforts will ultimately prove to have been effective in preventing such failures.

Efficiency vs. Banker Control

For more years than most living people can remember, Erie railroad has been one of the "joke" systems of the country. Whenever, a jokesmith thought up a new one or a variation of an old one having its supposed point in the defficiencies of railroad service, it is suposed to have happened on the Erie. Whether or not the Erie was responsible for all the faults laid at its door, we do not know but it has been cited as a shining example of faulty financial structure and inefficient operation.

Two or three years ago, control of the road was taken over from a group of bankers by a group interested in the operation of the system and since that time the situation is reported as being much changed. An experienced operating official was placed in charge and many changes were put into effect. As a first indication of improvements it was reported that the road began discounting its bills for supplies and equipment. Obsolete and in efficient equipment was scrapped and new equipment was purchased. Net operating income has taken a turn upward and there is now talk of a rearrangement of capital structure which will permit the payment of dividends on preferred stock.

The change is ascribed to the fact that the present management is directly interested in the financial results of operation while the former banker control was interested only in stocks and bonds and how they acted on the stock market.

The success of a large number of independently owned telephone companies has been due to the

same cause as is now given as the reason for the improvement in the condition of the Erie; namely the fact that the operating people in charge had a direct financial interest in the results of the operations. Control has frequently been in the hands of a small group including the active heads of the companies.

One of the important questions that will arise out of the present wave of buying and selling telephone properties is where the control will lie after the wave subsides and ownership becomes stabilized. Will the common stock be in the hands of those who are operating the property or in the hands of those who have issued and sold bonds and preferred stock and having made the sale and the profit have little interest in what becomes of the property other than it meets fixed charges?

There have been some Erie railroads among Independent telephone properties and some of them under new and progressive management will snap out of their lethargy and will become live, up-to-date systems. No doubt some of the present splendid properties will find owners who are interested only in selling securities and they will speedily slip down into the position that Erie railroad has been in all of these years. For the good of the industry it is to be hoped that there will be few of the latter class.

Out of the Rut Into the Saddle

A number of years ago a young lineman approached his superintendent and asked for an increase in wages. The superintendent objected saying: "You are now getting the highest rate that the company pays for linemen." The young man said, "Then give me a transfer to some other department where I can learn more and earn more." The superintendent replied: "You are too good a lineman. Better stick to the line job." The lineman having a small family of growing youngsters and a neat little home partly paid for, found no alternative but to stick to the line job.

The story moves ahead a few years and both men are still working for the same company. The former lineman is now superintendent and the former superintendent has been shoved aside into another job of merely routine work. At the time the story begins both men were in a rut. The one knew it and while he stuck to it, developed himself and ultimately was discovered by the higher-ups and was given advancement. The other, likewise in a rut, did not know it and soon had his department in a rut. He failed to develop with the business and when reorganization of the department became necessary he was painlessly shelved and his place given to the man who could grow with the job.

Standardization Helpful to the Industry

A chronicle of many important standardization activities in American industry is contained in the Year Book of the American Engineering Standards Committee which has just been issued. Forty-nine new standards and forty new projects are listed in the various branches of industry and engineering. The telephone industry is represented by the Telephone Group made up of the Bell Telephone System and the United States Independent Telephone Association, either jointly or individually, co-operating in the formulation of standards in over twenty different projects.

Some of the projects of especial interest to the telephone industry are those involving standards for wood poles, steel poles, copper wire, manhole frames and covers, dry cells and lighting protection. Among the standards which have been issued are the National Electric Code, the revision of the National Electrical Safety Code, symbols for electrical equipment of buildings, and tubular steel poles. The standards for dry cells is in the press.

An important feature of the standardization work and one that is not always understood is that the standards are developed by industry itself, under the guidance of a "'sponsor" body and with the co-operation of all interested parties. The main committee is not the standardizing body, but merely assures itself that standards are wanted and that the standards finally developed represent agreement within the industry affected before the standards are approved and published. Thus, the development of standard specifications for wood poles is being carried on under the sponsorship of the Telephone Group with the co-operation of the American Forestry Association, American Institute of Electrical Engineers, American Railway Association, American Society for Testing Materials, American Wood Preservers' Association, National Electric Light Association, Pole Producers' Association and various other bodies interested in the production and utilization of forest products.

While only a few standards of direct interest to the telephone industry have been published, work is progressing on the others and new projects will be taken up from time to time as the industry finds that they are desirable and initiates the proceedings necessary to begin work. There are many opportunities for further standardization in the telephone field that will benefit both manufacturers and operating companies. They only are waiting for the industry to realize their need and to commence work upon them.

Studying Telephone Methods

By E. R. COLLINS

Manitoba Telephone System, Brandon, Manitoba, Canada

CHAPTER XVIII

In the previous chapter we discussed some of the methods that might be used to locate trouble on the lines connected to the exchange. In addition to such, it is quite necessary to have some form of test set, permanently installed in the exchange. This set should always be maintained in good shape.

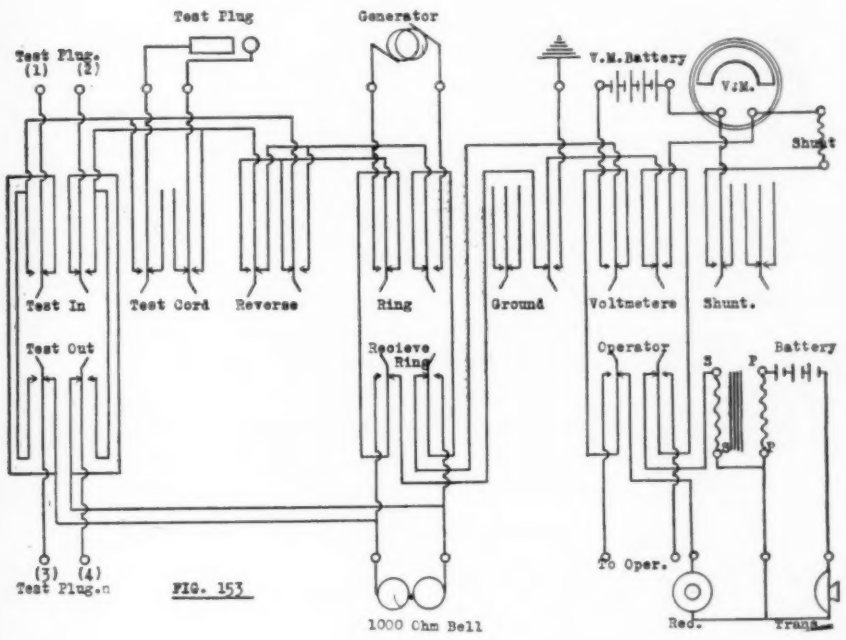


FIG. 153

In Fig. 153 is given a typical test circuit that might be used for a small exchange. The keys can be mounted in the face of the test panel, or can be mounted in a horizontal position such as in an operator's key board. In the small country exchange the rack and the switchboard are often quite close together, and in such case the testing apparatus can be conveniently placed on one end of the switchboard. When this is done the operator is able to test lines quite readily without calling for any assistance from a test man.

In Fig. 153 there is shown a test cord connected to the test key. If this is connected to an extra cord on the operator's position, so that it can reach all the lines on the board, then any line can be tested from the test set, through the line jack, switchboard cables, heat coils, and other rack connections. In other words the test will be conducted over the same circuit that is used by the subscriber in actual use. The relation of every line will thus be the same to the test board on account of using the test plug. That is the tip of the test plug will always be connected to the tip of the line under test. We will therefore call this side of the lines the "line side" and the other the "return side." In the drawings following this practice will be followed.

Normal Position of Keys

We will suppose that all keys are normal or closed. Then there will be no circuit completed outside of the test circuit. Now if the test cord is operated, and the test plug connected to a subscriber's telephone, the circuit can be traced from the tip of the test plug, through the right make spring of *test key*, left normal springs of *reverse key*, right normal springs of *ring key*, right normal springs of *receive ring key*, left normal springs of *voltmetere key*, left normal springs of *operator key*, through receiver, and secondary of induction coil, back over the right normal springs of *operator key*, right normal springs of voltmeter key, right normal springs of *ground key*, left normal springs of *receive ring key*, left normal springs of *ring key*, right normal springs of reverse key, left make springs of *test cord key*, over sleeve of test plug to the subscriber's telephone. This may seem like a long, tedious way of tracing out this circuit, but it is what you invariably do when following the circuit of any apparatus.

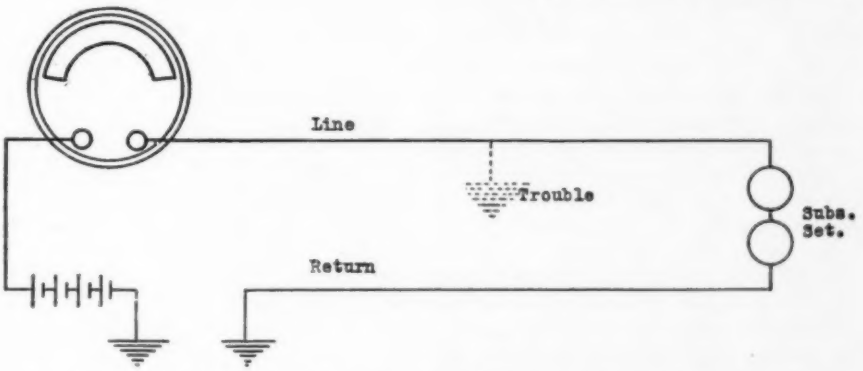
If a beginner finds it difficult to follow the changes in circuit of the keys, etc., a very simple plan is to place a button or washer on the keys as they are operated mentally, and then you will have something to remind you of the position the key should be in.

If the operator key is operated, the switchboard operator's circuit connected to it will not follow the same circuit as the talking circuit of the test set will be followed to the test cord.

Testing Battery

It is quite common in common battery exchanges to use the exchange battery for testing. For the small test set, where dry cells or other supply are used, it is much simpler if no ground is connected to the battery.

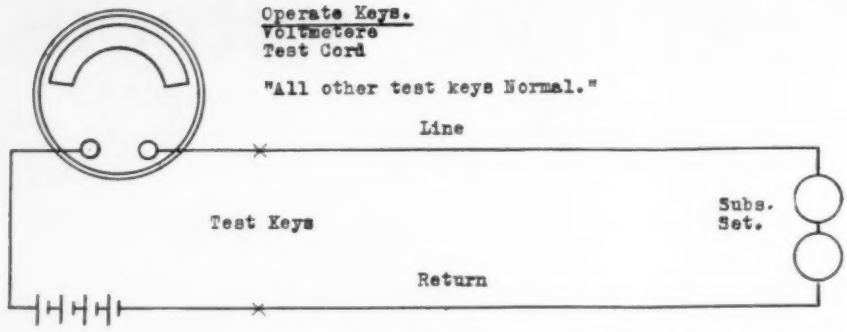
Referring to Fig. 154, the test battery



Testing Loop of Line using a battery with a permanent ground on one side.

Fig. 154

is permanently grounded. Therefore to test the loop of a line it is necessary to ground the return of the line at the exchange, while the battery flows through

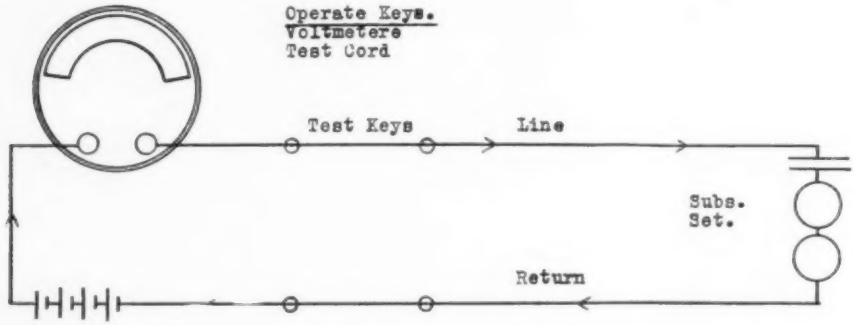


Testing the loop of a line with a battery permanently free of ground.

Fig. 155

the voltmeter over the line side to the ground at the exchange on the return side. But suppose there is a trouble as shown by the dotted ground on the line side. Then the battery will flow to ground on the line side. Then the battery will flow to ground at trouble, and the voltmeter will indicate a closed circuit, when at the same time the circuit might be open further away from the testing point, and yet not be detected.

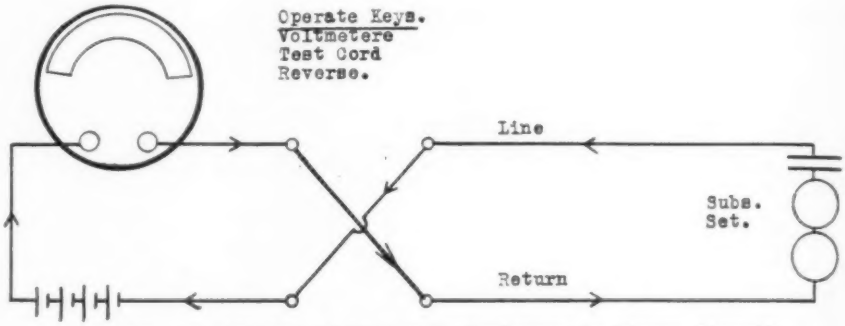
In Fig. 155 is shown what is meant by a metallic battery circuit. Here there is no ground connected to the battery. The circuit to be complete must traverse the whole of the line to give a deflection of the voltmeter. A ground such as is shown at the dotted point in Fig. 154 would not interfere with obtaining the



Testing continuity of a line with a condenser in ringer circuit.
Charging the Condenser.

Fig. 156

circuit reading through the ringer coils at the subscriber's telephone. We will suppose there has been a thunder storm. There will likely be several lines open due to open fuses. Such condition can be quickly checked by the operator using a test set on her switchboard. A rather amusing incident occurred several years ago in Ontario. A line was reported out of order. We had no voltmeter test sets in those days, and so depended on the generator tell tale to find if the line was open or short. This was a long line, and gave quite a loud ring on the tell tale. A man was sent out to repair the trouble which we thought was an open fuse. He changed the cable fuses, and went to the subscriber's premises. We used the old No. 10 cut out which was a porcelain fuse block, fused with a fine piece of wire usually taken out of an old heat coil.



Testing Continuity of line with Condenser in Ringer Circuit.
Discharging the Condenser.

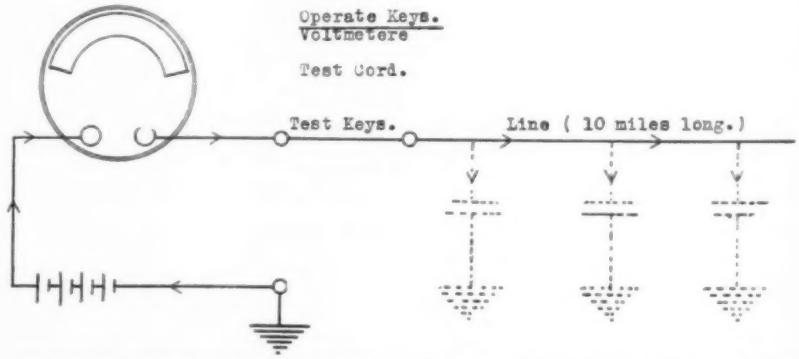
Fig. 157

Bill reported the fuses O. K. and yet the line was no good. After several trips had been made with the old gray mare and the democrat, one of the men discovered by using a test set that he could ring Central from one side of the fuses at the No. 10 cut out, and ring the subscriber's telephone from the other side. Yet the fuses were all O. K. But the joke was that both the fuses were composed of horse hair, which Bill had mixed up with his fuse wire.

The point is that if a voltmeter test set had been used, the trouble might have been cornered up much quicker. Testing a line to see if the circuit is complete and not broken is called a *continuity test*. For a line as shown in Fig. 155 only operate test keys as follows: *Test cord*, and *voltmeter*. *Continuity with condenser.*

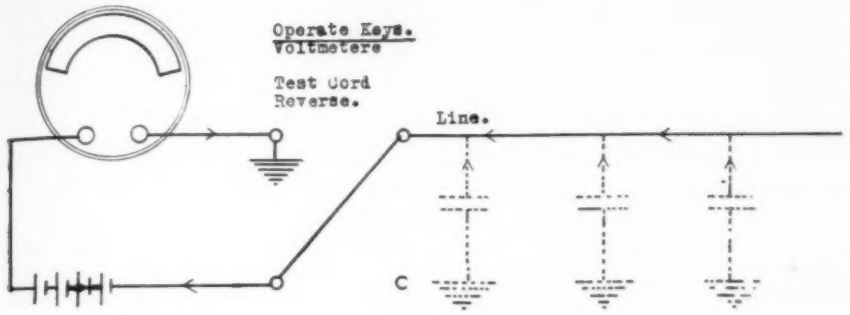
When a condenser is included in the ringer circuit, there will be no path for the battery to flow. However, we can check the condition of a line by using the voltmeter in two operations.

Referring to Fig. 156, if we operate the voltmeter keys and the test cord key there will be a small deflection of the needle of the voltmeter, and then it will remain at zero. If the meter had its zero point in the center of the scale, there would be two movements. One to the right when the battery current flowed out on the line, and charged the condenser at the subscriber's telephone and then a deflection to the left as the condenser tries to discharge in the opposite direction. However since the battery polarity will be opposing this charge, the deflection of



Testing capacity of line to Ground. Charging the capacity of the line wire.

Fig. 158

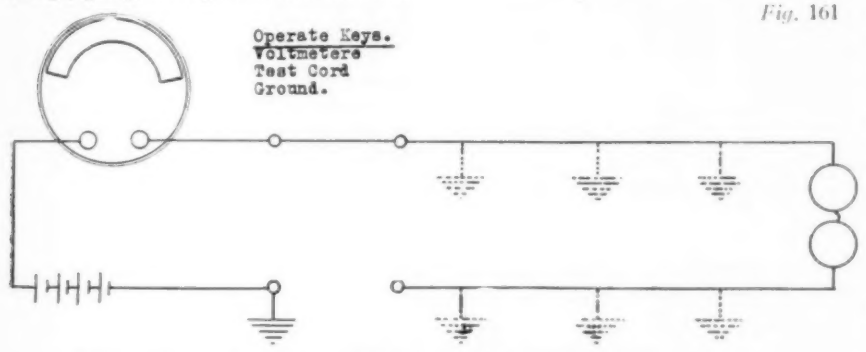


Testing capacity of line to ground. Discharging the line capacity.

Fig. 159

the needle will be very small. Fig. 156 shows the condition of the circuit when the line is being charged as indicated by the arrows, flowing out over the line and back the return side.

Now throw the reverse key leaving the voltmeter and test cork keys still operated, and the discharge current from the condenser and the breakdown of the energy stored up in the ringer coils will flow back over the line. But here it is deflected to the other side of the voltmeter circuit by the reverse key, so that the discharge from the condenser is in the same direction as the battery flow. So now we have the battery flow voltage plus the voltage of the condenser discharge, going through the voltmeter and ground. Then operate the voltmeter and test key only. The battery will flow from ground through the voltmeter circuit, out on the line wire charging it the same as a condenser. This will cause the needle of the voltmeter to deflect to the right. Then operate the reverse key, and the discharge is allowed to flow through the voltmeter in the same direction as the battery. Operate the Reverse key at a uniform speed, and the needle will hold quite steady. Assume the deflection is 3 on the scale of the meter. This will be the reading for 10 miles of line. Now connect the tip of the plug to the short section of the line, and suppose the deflection is 1½ on the scale of the meter. Then the distance to the break would be just one-half of 10, or 5 miles. A more complete method of testing for opens will be dealt with in subsequent chapter. The use of the reversing key plays a very important part in the test desk circuit.



Testing the leakage of a line to ground due to dampness.

Fig. 160

we get a larger deflection than we would have had with the battery voltage alone.

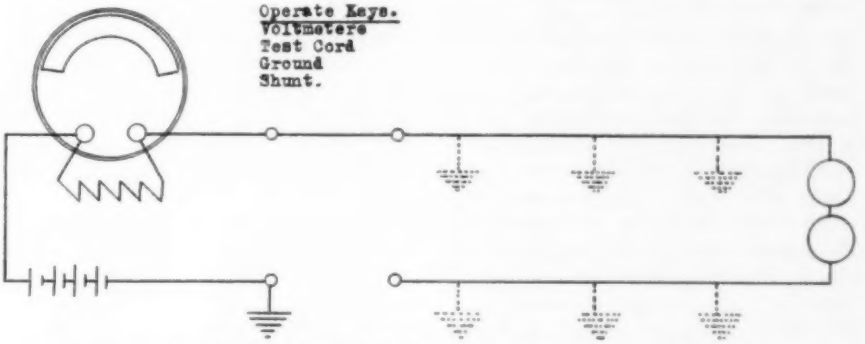
If the voltmeter and test cord keys were operated, and the reverse key operated several times at a uniform speed, the voltmeter would indicate an almost continuous reading, as though battery were flowing over the line.

Testing an Open Line

We will suppose we have a long distance line 10 miles long. This line would be above the earth, say, 20 or 25 feet, and would form one plate of a condenser. The earth beneath it would be the other plate of the condenser, and the air between the insulator or *dielectric*. The capacity of this condenser will depend on its length, and its distance from the earth. In Fig. 158, connect one side of the line that is open to the tip of the test plug, and the sleeve of the test plug to

Line Leakage

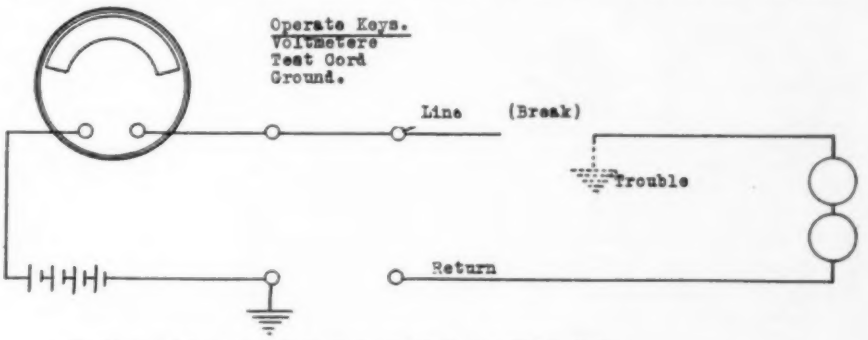
In Fig. 160 is shown a line connected to the test set, using the voltmeter, test



Testing the relative resistance of the leakage of a line to ground.

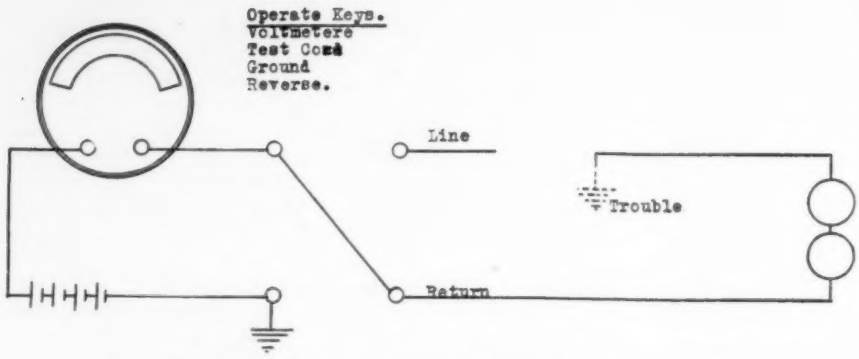
Fig. 161

cord and ground keys. We will assume there are trees projecting into the line, insulators broken, allowing to line to come in contact with wet crossarms, or creosoted arms or poles. Then there would be a deflection of the voltmeter. But the meter needle might go over the full distance of the scale, and give the tester the impression of a heavy ground at some point, whereas it is the addition of several high resistance grounds as shown by the dotted lines to ground. Such a reading will give an indication of trouble, but little indication of the value of the trouble. The reason is that the voltmeter coils are of high resistance and therefore will respond to a current of very small value. It is necessary to have the meter sensitive or else it would not detect a high resistance ground at all. But the meter must be made less sensitive



Testing a line grounded, but obtaining a Clear Test.

Fig. 162



Testing a grounded line to locate a trouble on same.

Fig. 163

to give any idea of the relative resistance being measured.

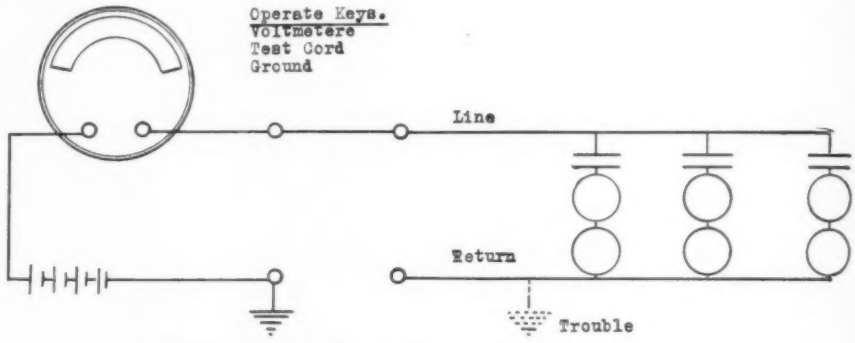
In Fig. 161 we have operated the shunt key. This places a low resistance non-inductive coil across the terminals of the voltmeter. We will suppose this coil is a little more than 400 ohms, and the resulting resistance of the voltmeter and the shunt give an even resistance of 400 ohms. Then to measure the resistance of the leak to ground in Fig. 161, we would use the following calculations.

1. With the shunt key operated, read the value of a short circuit on the tip and sleeve of the test plug. Say the reading is 30.
2. Read the voltmeter with the shunt key operated and connected as in Fig. 161. Suppose the reading is 20.
3. Subtract reading No. 2 (20) from reading No. 1 (30) equals 10.
4. Multiply the difference by 400 the resistance of the voltmeter and the shunt, equals 4,000.
5. Divide 4,000 by the reading of the line (20) equals 200 ohms, the resistance of the line to ground.

Thus the addition of a shunt carefully calibrated to give with the voltmeter an even resistance makes the voltmeter useful to measure resistance as well as to detect leakage.

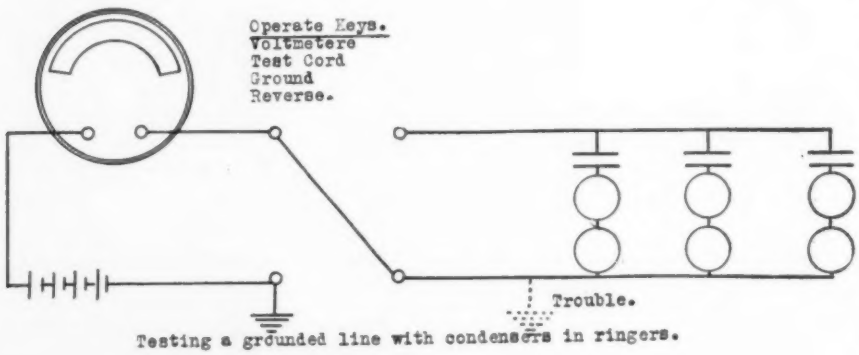
False Tests

We will assume a line is open to ring on it. Some men have the idea that if they test one side of the line that is all that is necessary. Some type of heat coils will open the line toward the switchboard, but ground the line as in Fig. 162. Now if the voltmeter is connected to the line as in Fig. 162 and the needle gave a deflection, due to the capacity of the short end of the line, if this were on a system using condensers in the ringer circuit, the deflection obtained might be sufficient to satisfy the tester as being O. K. However, in the case of Fig. 162 this is a magneto circuit, and only the line side has been tested. Therefore it might be put down as open. However, operate the reverse key as shown in Fig. 163, and here we find the line is grounded. Again, in Fig. 164 we have a line equipped with condensers in the ringer circuits. The tester is in a hurry and does not test both sides of the line. The line wire tests clear of ground and might be passed as O. K. However, operating the reverse key as shown in Fig. 164 will show that the line is grounded. The use of the reverse key here again is important.



Testing a grounded line with condensers in ringers.

Fig. 164



Testing a grounded line with condensers in ringers.

Fig. 165

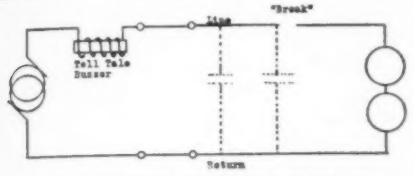
Ringing Tests

The test circuit in Fig. 153 does not show the tell tale buzzer in the generator circuit. This is connected in series with the generator, and is usually about 100 ohms. It is often noticed that a line tests clear with the voltmeter, and yet when we ring on it, the buzzer will operate. This is due to the capacity effect of the line wires.

In Fig. 166 we show a line connected to the generator. The line is open at the point "break." There is a capacity or condenser effect between all parallel surfaces in a circuit, therefore the line wires act as condenser plates. The distance between them determines the capacity, as well as the amount of the parallel surface. On the cross arm the lines are held quite a distance apart, and therefore the capacity is less than if the same size wires were ½ inch apart. In the telephone cables the wires are smaller but are close together, therefore the capacity is much higher. In Fig. 166 the buzzer operation is due to the addition of all the small capacities of the line wires, and the intensity of the buzz will depend on the length of the parallel wires in the circuit. In Fig. 166 the generator is not grounded. But in Fig. 167 the generator is grounded. Here in addition to the capacity between the two sections of parallel lines we have the capacity of the *line* to ground. The grounded generator will therefore give a louder buzz than the metallic generator in Fig. 166.

Now if the reverse key is operated, as in Fig. 168, the live side of the generator will go out over the return side of the line. Here we have the capacity of the line to ground as indicated by the dotted lines over the return side of the line, through the ringers, and the outer end of the line side of the circuit. In addition to that there will be the capacity from line to line over the exchange end of the

line. It is possible to ring the telephone at the distant end of the line by operating the reversing key at the test desk. This is often resorted to in testing toll lines, when it is desired to call a distant exchange over an open line. For this reason the reverse key is connected ahead of the generator key in circuit 153.



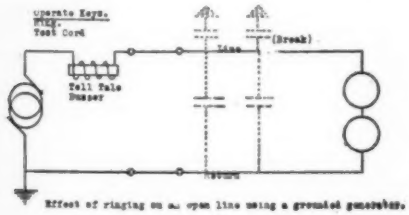
Reason for buzzing of a toll take on an open line.

Fig. 166

Temporary Service on Rural Lines

Rural lines using push buttons, for calling the operator, are easily upset by grounds. These lines are also subject to the lightning induction, and become grounded quite frequently. If the line as shown in Fig. 169 is grounded at the point marked "trouble," the signal at the exchange will not operate if the generator at *ringing subscriber* is operated. The resistance of the ground will determine the extent to which the line will be interferred with. Points (1), (2), (3), (4) represent the line and switchboard terminals of the rack. If the jumper was reversed at this point, then the current from the ringing subscriber would find a path through the bells of the line to point 3, then across to point 2 and then through the line signal to ground.

To save reversing the jumper, it is more convenient to wire up one or more test plugs as shown in Fig. 170. This is simply a rack test plug or test shoe as they are commonly called, with No. 1 connected to No. 4 and No. 3 to No. 2. Simply remove the heat coils, and insert a test plug wired as per Fig. 170 and the rural line will be able to get service temporarily.



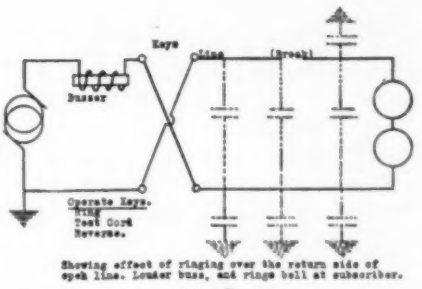
Effect of ringing on an open line using a grounded generator.

Fig. 167

Test In and Out

The test in and test out keys are connected to a test plug such as shown in Fig. 170. If the heat coils are removed and the test shoe inserted, then a circuit can be traced from the line through the keys to the switchboard. The subscriber can use his line even if the test plug is left in, provided the keys are normal. The operation of the test in key will connect the testing circuit to the line signal. This allows the line to be tested in. The test out key allows the outside condition of the line to be tested as well.

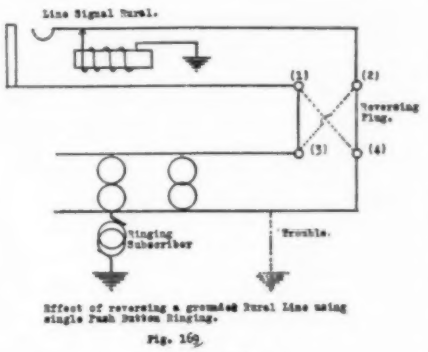
A rural line grounded on one side, that



Showing effect of ringing over the return side of open line. Louder buzz, and rings bell at subscriber.

Fig. 168

will not be able to call the operator in the usual manner, can call the operator (if connected to the test shoe) with the keys normal. All the metallic rings on the line will operate the 1,000 ohm Bell connected to the inner springs of the test out key.

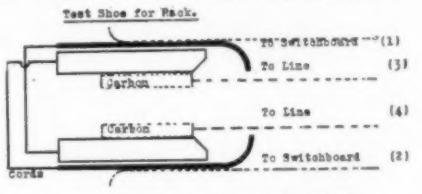


Effect of reversing a grounded Rural Line using single Push Button Ringing.

Fig. 169

Receive Ring

Provision is also made to receive a ring from a subscriber by operating the receive ring key. This connects the 1,000 ohm bell across the circuit being tested.



Test shoe or Plug used to reverse Line Wires.

Fig. 170

There are many different designs of test sets. A type suited to the service being rendered is available for every exchange. Testing equipment is not a luxury but a necessity. The money invested in good test apparatus will soon be saved in livery expense and labor charges. But it is necessary to understand the many uses of the testing apparatus provided. If there is any test that is not clear, try drawing out a skeleton circuit of the conditions met such as in the foregoing drawings. We have only been able to cover a few of the conditions met in testing, but the writer has found that the time spent with a pencil and paper drawing out the circuit, or section of the circuit in any test, will help to determine quickly what the trouble will be before any work is done on the circuit at all. In the next chapter we will consider some of the problems met in supply talking and ringing current for the small exchanges.

Convention at Wawasee Has Good Attendance

The annual summer meeting of the Northern Indiana Telephone Association held a three day session at the South Shore Inn, Wawassem, Indiana, June 19, 20 and 21.

Aside from its entertainment features the business transacted proved time well spent for those in attendance. About 200 registered for the meeting the second day.

The program consisted of a talk on "Radio as Is" by D. H. Minor of Kansas City. This subject was very thoroughly discussed and much information was gathered by those listening in.

"Rebuilding the Small Exchange" was a subject handled by Sam Tomlinson of Plymouth, which brought forth considerable discussion.

Talks were made by Frank A. Baker of Fort Wayne on "Drop Wire Maintenance," and Ralph Rex, also of Fort Wayne, on "Cable Trouble."

"Commercial Problems" by A. E. Smith of Indianapolis, general traffic superintendent of the Indiana Bell Telephone Company. He went into the problems confronting the management of telephone properties and discussed the possibilities of increasing revenues from many sources. Mr. Smith's talk was the outstanding feature of the program for Wednesday.

Operators' conferences were held each day, and attendance was unusually large. Wednesday's session was presided over by Miss Ethel Angling, and on Thursday Miss Belle Bernetha presided.

A round table discussion on Thursday brought the session to a close after the election of officers, which showed the following results: President, Roscoe D. Pontius, Rochester; vice president, A. E. Yearick, Walkerton; secretary-treasurer, Theo. Stoops, Nappanee; directors, Horace Larue, N. Manchester and Fred Pyle, La Porte.

It was voted to hold the September meeting at Nappanee, date to be selected.

Liverpool Man Studies Home Telephone Company Methods

W. O. Passmore, developmental engineer for the Automatic Telephone Manufacturing, Ltd., of Liverpool, England, has arrived in Fort Wayne where he will spend this week at The Home Telephone and Telegraph Company plant.

Mr. Passmore is planning to be in America for five months in study of the American methods of telephone operations. One week will be spent in extensive research and study of the plant here, which is considered the most modern in the world. While in Fort Wayne this week, Mr. Passmore will go extensively into plant operations here, specializing on the traffic operations and system in the plant department.

Practical Suggestions for Plant Valuation

By CHARLES W. McKAY, M. E.*

CHAPTER XIII.

In the June installment we prefaced the subject of determining the present condition of buildings. As suggested in this installment I have a word or two more to say on this subject. We mentioned the factor of obsolescence. Just because a building is old—if it has a long expected life—it should not be considered as obsolete providing it is well adapted for telephone purposes. In other words, I have seen buildings which are rather "antique" as to their general appearance—but which have a long expected life and are perfectly suited for telephone purposes (at least in the community in which they are located) and hence such buildings should not be excessively depreciated from the standpoint of inadequacy and obsolescence. As a matter of fact, they serve their purpose quite as well as a more modern building and it would be very foolish for the operating telephone company to discard such a building and replace it, at high cost, by a more modern building—*always assuming that the building is fit for the purpose it now serves.* In other words, that it is well suited for telephone central offices' purposes.

In conclusion, with respect to the subject of buildings, the life of a building may range from twenty to fifty years, depending upon the type of construction. Of course we do not expect a frame building to last as long as a modern concrete building—this on the basis of wear and tear and age (otherwise physical depreciation) and not necessarily on the basis of inadequacy or obsolescence.

In the last analysis, we must use our common sense in estimating the unexpired life of a building for telephone purposes and in so doing we must take into consideration the type of construction (whether frame, brick or concrete—in other words, the physical factors) and we must also take into consideration the factors of inadequacy and obsolescence.

Outside Plant

We have already discussed, in some detail, the methods of determining the condition of the various component elements of outside plant. Just a word as to the method of recording these data. It will be remembered that in previous installments, some months ago, forms were indicated for recording the inventory of outside plant. Of these forms, especial columns were provided for recording the condition of each classification of plant. For instance, on the pole forms—one column was provided for recording the condition of the poles; another column was provided for recording the condition of the crossarms; a third column was provided for recording the condition of the anchors and guides, and still further columns were provided for recording the condition of the aerial wire, etc., which for the sake of convenience was inventoried in connection with the pole plant.

In a similar manner columns were provided on the aerial cable sheets for recording the condition of cable and strands—other columns were provided for recording the condition of terminals, etc., etc.

If you will glance back and review these various forms you will also find that proper columns were provided for recording the condition of underground cables; underground cable terminals; underground conduit, manholes, etc.

It is hardly necessary to comment further on this phase of the subject—and we now enter into an entirely new branch of the subject of valuation for rate making—and that is the determination of the collateral construction costs. The collateral construction costs, it will be remembered, are so closely allied to the direct construction costs as to warrant their inclusion with the latter under the heading, "Cost of Physical Property." They are really part and parcel of the cost of physical property, and it is only for convenience that they are not included in the unit costs.

Obviously, such items as general and legal expense, engineering and general supervision, referring as they do to practically the entire property, can be more readily determined by considering the problem as a whole rather than by trying to allocate these items to the various unit costs of pole line, aerial cable, etc., construction.

In many of the more recent appraisals, however, no attempt has been made to segregate the direct and collateral construction costs. Items of collateral cost in these cases are given in the proper order after the items of direct cost, without the introduction of the distinctive headings of "Direct Construction Costs" and "Collateral Construction Costs." In this way the close bond between these two subdivisions of total physical cost is emphasized.

Before taking up the discussion of the various elements of collateral costs, let us consider for a moment just what happens prior to, and during the early stages of, the construction of a utility property.

First comes the conception of the idea. If the plant under consideration is a telephone plant, some practical telephone man usually first sees the opportunity for a new company. Or it may be that a group of prominent citizens, dissatisfied with the service of the existing company, conceives the idea of starting a competitive enterprise financed by local capital.

In either case the next step will be the discussion of the project with others who may be usefully interested, especially those who may be of direct financial assistance.

If, after conferences, the project still seems feasible, engineers will be employed to make rough estimates of costs, and to outline, in a general way, the scope of a property adequate to give the desired service. The consideration of the engineer's report will probably necessitate a number of conferences, and possibly several inspection trips.

If the financial backers are favorably impressed with the findings of the engineering staff, the next step will be the employment of legal counsel to take the preliminary measures toward obtaining the consent of the state public service commission, the securing of municipal franchises, and for general advice in whatever other organization problems may arise.

In some states a "certificate of public convenience and necessity" is required before a new utility can enter the field. In other words, the promoters have to prove to the state public utility commission that there is a real need for a new utility corporation before the commission will consent to its establishment.

After the consent of the state commission has been obtained, the work of securing a municipal franchise is taken up in earnest. This, as, a rule, is a rather serious problem, involving many conferences and considerable loss of time. Factions of the city government may have to be conciliated, for political or other reasons.

Next comes the organization of a cor-

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poration to take over the franchise and build the plant, the acquisition of the necessary real estate and the preparation of specific engineering and architectural plans for the construction of the plant.

From the foregoing it will be seen that very appreciable expenditures have to be made before a single item of the inventoriable portion of the plant is brought into existence. No fair-minded person can for a minute question that these expenditures are just as much a part of the cost of the property as the cost of placing poles or stringing wire.

All of these expenditures, with the exception of the cost of securing franchise (other than legal costs), and the cost of raising money for plant construction, fall under the collateral costs.

The subject of collateral construction costs will be continued in the August issue of TELEPHONE ENGINEER.

Opening Telephone Service Between United States and South America

An event important in the history of telephone communications of the world and particularly of South America, took place June 22nd when International Telephone Service joining Argentina, Chile and Uruguay was officially inaugurated by the presidents of the respective countries.

Telephone service between Chile, Argentina and Uruguay is of great importance as it signifies opening a new means of interchange, and at the same time is a tangible sign of progress in the field of communication, as this circuit is the most extensive in South America and has been constructed in accordance with the latest telephonic devices.

The joint co-operation of the associated companies of the International Telephone and Telegraph Corporation, namely, Compania Telefonica Argentina, the Chile Telephone Company, the National Co-operative Telephone Company Montevideo and All America Cables, Inc., made possible the conclusion of this vast plan of communications, which inaugurates the extensive project of the International Telephone and Telegraph Corporation to join diverse countries of this continent through a network of communications which will also make possible in the future communications with the United States and Europe.

New technical problems and difficulties were encountered in construction of these circuits which, beginning in Valparaiso, Chile, on the Pacific Ocean, traverse the broken and mountainous country of Chile, the range of Andean Mountains, the vast Pampas of the Argentine, and, for 66 miles follow the bed of the mighty Rio de la Plata by means of subfluvial cables finally arriving at Port of Montevideo on the shores of the South Atlantic thus linking the two seas. The means of communication employed are telephone circuits superimposed, for a great part of distance, on the telegraph wires of the All America Cables International Telegraph lines which make use of subfluvial cables between Uruguay and Argentine, and of subterranean cables across Andes Mountains so as to avoid interruption caused by constant heavy snow storms and more particularly snow avalanches. Amongst these mountains, near the tiny hamlet of Las Cuevas in Argentina there is one of the greatest heights ever crossed by any telephone circuit in any part of the world, namely 12,300 feet.

These circuits form vertebrae which will join these countries telephonically in the future. Technical problems have been overcome by employment of the most modern scientific methods and other new provisions which had to be made due to difficulties involved in installing these circuits which extend over 1,125 miles between Montevideo, Buenos Aires, Santiago and Valparaiso, making necessary the employment of more than 22,000 poles and of the latest communication methods as problems entirely new in the communications field were encountered. Particular trouble was caused by failure of transportation due to heavy snow storms and slides, making necessary the use of pack mules to transport the necessary materials and equipment.

Eleven repeater stations were installed at strategic points along route across the three countries. Three of these repeaters were installed in the Andes Mountains where attendants during winter season are isolated for months at a time due to the heavy snow falls. These snows in addition to being hazards to the physical construction of the line also present natural difficulty to the work of the repair men and necessitate the use of snow shoes and other improvised methods for inspection and repair of the line during at least three months of the year.

Telephone Service Now Available to German Republic

Transatlantic telephone service to the entire German republic has been established it was announced by the Illinois Bell Telephone Company. Heretofore the service has been to seven German cities only. On the American side the service will include all parts of the United States and Cuba and the principal cities of Canada.

The hours of service for transatlantic calls to all foreign points were extended one hour on June 4, making connections possible from 5:30 a. m. to 9 p. m., Central daylight saving time. These hours will correspond to 12:30 p. m. to 4 a. m., German summer time.

The rate to all points in Germany will be the same as the present rates from this country to Berlin. Thus, a Chicago call to any German city will cost $53.25 for the first three minutes and $17.75 for each additional minute.

At the present time transatlantic telephone service is available to all of Great Britain and to individual cities on the continent of Europe. With this addition of all German telephones, any American business or residence telephone may be linked to any one of nearly 25,000,000 out of the estimated 31,000,000 instruments in the world, or 80 per cent of the total.

Germany has approximately 2,850,000 telephones, or more than any other country in Europe, and second only to the United States. It is the first country of continental Europe to which general service has been established from America. Such service was extended to Great Britain last year.

Every known type of electrical communication circuit is employed in establishing these voice channels. A call from Chicago to Konigsberg, East Prussia, would travel over land by open wire and cable to New York, whence it would be sent to the radio transmitting station at the tip of Long Island. From here it would be flashed through the air to Great Britain. Passing through London it would dive through a submarine cable under the North Sea to Holland, cross Holland and Germany over land wires and finally reach the Baltic Sea. Here it would again enter a submarine cable that would carry it around the territory of Poland bordering on the Baltic Sea, and so to Konigsberg on the mainland. In all it would pass through four countries, two submarine cables and one radiophone circuit and cover a distance of more than 5,000 miles in approximately one-fifth of a second.

Transatlantic telephone service between America and Copenhagen, Denmark, through London, was opened Friday, June 29. The service on the American side includes all of the United States and Cuba and principal cities of Canada.

Denmark is the seventh European country to be connected with America by telephone. The overseas line is now in operation from 5:30 a. m. to 9:00 p. m., Chicago daylight saving time, which corresponds to 12:30 p. m. to 4:00 a. m. in Denmark. The rate for a call between Chicago and Copenhagen will be $54.75 for the first three minutes and $18.25 for each additional minute.

A Chapter from Modern Physics

By F. J. DOMMERQUE
Fellow A. I. E. E.

Atomic Theory of Electricity

Since the advent of the twentieth century not only the theory of electricity but the entire physical science has passed and is still passing through a revolution. Not that the old conceptions have been discarded and replaced by new ones; they have undergone only modifications and extensions of which the layman has not yet fully become aware. Our interest here is restricted to the progressive advance of electricity in general and the effect this advance has had upon the art of telephony in particular. Volumes have been written about these advanced ideas, and it would mean an unnecessary repetition if we would attempt to cover the same ground again, our discussion will be devoted solely to the matter introductory to repeater and carrier current operation.

The old conceptions and doctrines of electricity are in no ways superseded, they are still useful and sufficient as a working basis in practice; we will only indicate in how far the old conceptions have to be modified to form an understanding of the new additions to the science which plays a prominent role in the modern achievements made in telephony.

The fundamental conception of the electric and magnetic field at right angles to each other and of their lines is still basic. It is a familiar experiment to demonstrate the magnetic field lines by sprinkling iron filings upon a sheet of paper and placing it over a magnet. A similar experiment will give an idea of the electric field lines. When a glass plate is covered on both sides with tin foil and the two sides are connected to a source of current of high tension, say 3000 volts; when next freshly powdered crystals of gypsum are sprinkled upon the glass-plate, then those crystals will form closed curves similar to the magnetic field line curves formed by the iron filings.

We also know that if an electric field exists or can be produced between two conducting bodies, those bodies form a condenser.

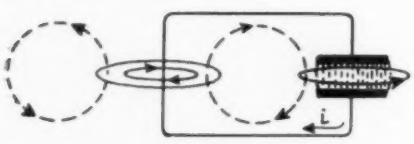


Figure 1

In Fig. 1 a schematic diagram is given showing the linking of the magnetic and electric field lines. The electric field lines are represented by dotted lines and circles and the magnetic field lines by full drawn circles. Magnetic field lines are closed curves, therefore have no ends. Electric field lines, however, can extend between two bodies separated in space, as for instance upon the plates of the condenser in Fig. 1, where the field lines fill the space between the two plates. Where the lines terminate upon the plates there are electric substances consisting of "electricity atoms" of which we will learn more presently. They are often referred to as the electric charge. The electricity atoms at the beginning of the electric field lines are of opposite sign to the atoms at the end of the lines.

If the two condenser plates are connected by a metallic conductor the electric field will disappear momentarily. Other bodies than metal also destroy the electric field for a shorter or longer interval of time. Even insulating bodies like amber, porcelain, etc., destroy it, only

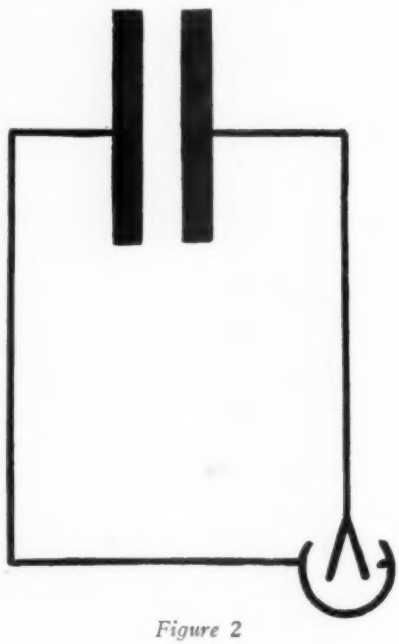


Figure 2

slowly, however, sometimes it takes hours. Consequently there is no absolutely perfect conductor and no absolutely perfect insulator. Therefore we define a conductor as a body which permits the electric field to disappear, and with it the atoms of electricity at the ends of the field lines. Consequently *a current is a migration of electricity atoms through a conductor.*

There exists a close relation between electric field lines and voltage. Suppose a static gold leaf voltmeter, consisting of two gold leaves attached to a metal rod suspended and insulated from a mounting frame is connected in circuit with the condenser as shown in Fig. 2, and a 220-volt lead from the city mains is touched for a short interval of time to the rod, then the gold leaves will diverge a certain amount. Then we increase the distance between the plates, thereby lengthening the field lines; the divergence of the voltmeter leaves will be increased, thereby, indicating an increase in voltage. We then decrease again the distance between the plates and the voltmeter leaves will come again closer together with corresponding decrease in voltage. This experiment shows that the voltage follows all changes in the field lines accurately and quickly. Similar experiments prove that it is immaterial whether the condenser is surrounded by air or placed in a vacuum; but the "electric field" is a particular state of space; the actions in an electric field are different from those in space without an electric field.

Further experiments, which to explain would lead too far into detail, prove that while electricity atoms migrate through conductors, they cannot migrate through insulators; that is, through "absolutely perfect" insulators. All insulators are characterized by a certain material constant which is called the dielectric constant. Taking the dielectric constant of air as 1, the relative dielectric constant of paraffin will be a little more than 2 and consequently the electric strain or tension in a charged paraffin plate condenser would be about halved; the electricity atoms in the paraffin condenser could move a little, although they could not migrate. Therefore electricity atoms have some freedom of motion inside the molecules of the insulator substance. This faculty is termed "displacement"; it causes a current to flow momentarily; the elastic reaction of the insulator resists the displacement, the electric strain due to a steady applied e. m. f. reaches a steady value and the current becomes zero. When the electric strain is subsequently allowed to diminish, a current exists again, but in opposite direction, this current is called a "displacement current." The important part is that in the inside of material molecules electricity atoms are present and can be displaced by external electric fields.

We have learned previously that electricity atoms migrate through a conductor. If a current flows in a conductor, the electricity atoms are on the surface

of the conductor and no electric field exists in its interior.

A conductor brought into an electric field contains in its interior positive and negative electricity atoms in equal amounts, but they are so distributed that their field lines are not perceptible on the outside. When the conductor enters the electric field, the atoms separate and follow the field lines until they arrive at the boundaries of the conductor, where the field lines are at right angles to the conductor surface. At the first moment a field exists also in the interior of the conductor. How long it lasts depends upon the conductivity of the conductor. Upon the boundaries of an electric field rest so many positive electricity atoms as negative; the positive electricity atoms are in nature always paired with negative electricity atoms, they are joined by the invisible tie of the field lines.

We have intentionally made a distinction between *electricity* atoms and *material* atoms. In the last thirty years much work has been done in the study of atomism. Before that time it was assumed that all matter was composed of atoms, material atoms, which were indivisible and therefore served the chemists as units for the weight of their elements. Modern atomism recognizes only two substances as fundamental elements, namely the atoms of positive and negative electricity. All the world is built up upon, and composed of, these electricity atoms. All mechanical processes are ultimately electric, with an electric field and electricity atoms at the base.

As we have seen there are positive and negative electricity atoms. The negative electricity atoms are commonly known as "electrons" and the positive electricity atoms as "protons." The electron theory has been pretty well established, but about the proton very little is known as yet.

It must be understood that there is no substance without electric field lines. In the material atoms and molecules they are not recognizable as long as there is an equal amount of positive and negative electricity atoms in them. Such material atoms or molecules are termed "electrically neutral." But as soon as there is one or more negative electricity atoms or electrons, as we may call them now, too many or too little, the material atom or molecule becomes an "ion." There are one-valued ions, two-valued ions, three-valued ions and so forth. A material atom which has one electron too many is a one-valued negative atom-ion; a material atom which has three electrons too many, is a three-valued negative atom-ion; a material atom which has two electrons missing, is a two-valued positive atom-ion; a molecule having one electron too many, is a one-valued negative molecule-ion, even if the molecule consists of two or more material atoms.

As far as the magnetic field is concerned, it is well known that all magnetic field lines are closed curves always; therefore there are no magnetic atoms, no magnetic charges, no magnetic substances. The electric field and the magnetic field, however, are closely linked together.

(1) A changing *magnetic* field is surrounded by ring-shaped closed electric field lines. (Induction.)

(2) A changing *electric* field is surrounded by ring-shaped closed magnetic field lines.

These two theorems are symbolized in Fig. 1. The current "i" in a conductor caused by the change in the electric field, is surrounded by magnetic field lines. In addition Fig. 1 indicates that also the electric field in the condenser is surrounded by magnetic field lines; that is, also the "displacement current" has a magnetic field.

One-atom substances, the molecules of which consist of one atom only, have also a dielectric constant. In their case the displacement of the electricity atoms takes place inside the individual atoms. In case of the molecules consisting of a number of atoms, the atoms displace themselves inside the individual molecules. Each molecule carries on one side the positive and on the other side the negative charge. The action influencing the individual molecules of an insulator is called "dielectric polarization."

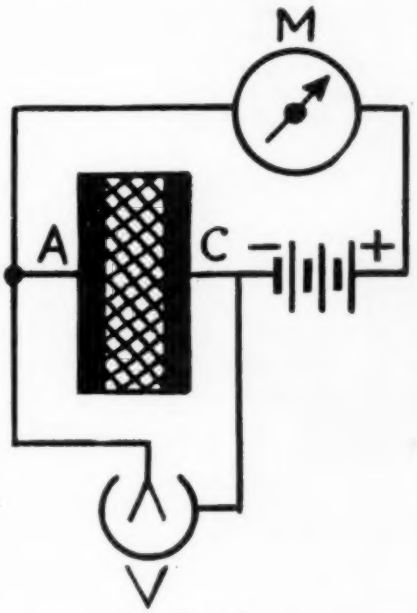


Figure 3

Movement of Electricity Through Gases

In Fig. 3 a condenser is represented with its plates connected by a conducting body, which is indicated by the cross-hatched lines. During the existence of this connection the plates lose electricity atoms, but the loss is made good by a source of current, here a battery, which sustains the electric field and the voltage. In this case the condenser plates or field boundaries are called the "electrodes," the positive electrode is the "anode" and the negative electrode the "cathode." By inserting an ammeter M in the current supply circuit and a static voltmeter V. in the branch circuit, the current can be measured, which is necessary to replenish the electricity atoms, and the voltage can be observed. The experiment gives the fundamental processes in any conduction of electricity, namely:

1. Electricity is bound to leave one electrode and go to the other electrode.

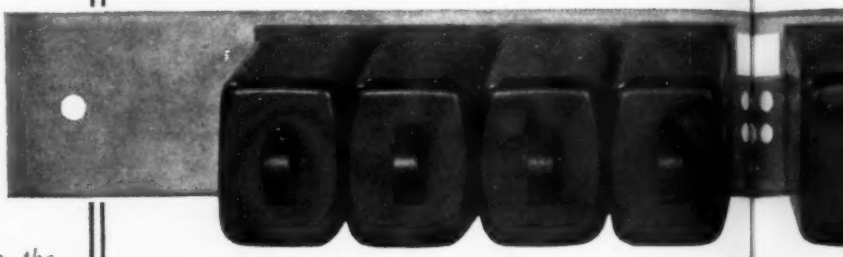
2. In the interior of the conductor are present equal amounts of electricity atoms of opposite sign which may be obtained from any source. The positive electricity atoms reach the negative electrode and the negative electricity atoms the positive electrode in some way or other. The most simple way to realize the above-stated process is to let the electricity atoms be transported by "electricity carriers."

In order to investigate the transportation or movement of electricity through gases, we commence with the most commonly known gas, the air, the molecular composition of which is well known. Each molecule has a diameter of 3×10^{-8} cm. and the distance between them is about 10 times as great. The molecules, however, have not a globular form, their figuration is immaterial, nor is the distance between any two of them always the same. They are in a constant motion, their movement velocity being about 500 meters per second. There are in round figures 3×10^{19} molecules in 1 cubic centimeter of ordinary air at room temperature. They do not move about in any regular formation but in most irregular paths. Room air forms a very good insulator. The electric field of the experimental condensers sometimes exists for hours in this air. As no charged electricity carriers exist in air they have to be brought into it by some means or other. We designate such a state as a "dependent" conduction, while in an ordinary conductor where the electricity carriers are present without introduction, we call the conduction "independent." Many bodies whether solid, liquid or gaseous, are not conductors, they become conductors only by the introduction of electricity carriers, only metal wire is always an independent conductor.

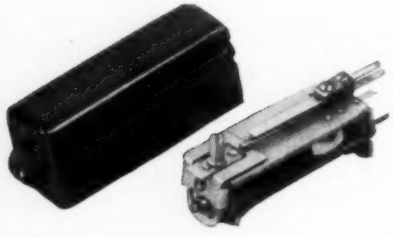
To illustrate and demonstrate the action of dependent conduction in air with visible electricity carriers we use a condenser, the plates of which are tubular instead of flat and so made that one tube or cylinder will be inside the other. The outside cylinder has at its one end a bottle-shaped neck to which a rubber tube is connected. This tube is attached to an atomizer so that fine dust can be blown through the

A Relay Team T's

Line Relay



The armature is pivoted on the forward end of the heelpiece. Adjustment is made by loosening a single stud and sliding into desired position. The springs are of the proper length and thickness with permanent micrometer adjustment. The contact points are of silver alloy. Each relay is furnished with pressed steel cover that prevents cross talk. This relay is 4¼ in. long and mounts on 1⅜ in. centers horizontally and 2⅛ in. centers vertically.



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a feature of every American ommon

American Compan

State and 64th Street CHI

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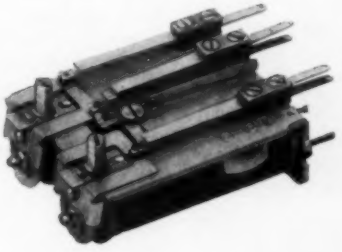
7th and Wyan Kansas City

T's Hard To Equal

Ring-up and Cut-off Relay

This is an arrangement of two armatures with a mechanical interlock so that the ring-up relay cannot release, after being operated, until the cut-off relay operates. The operation of the cut-off relay permits the ring-up relay to return to normal. Furnished with pressed steel cover that slides on the heel-piece and is held tightly in place by a spring riveted on the heel-piece and pressing outward on the cover. Mounts on the same centers as the line relays.



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condenser. A source of 220 volt current supply is connected to the condenser so as to make the inner cylinder the cathode and the outer cylinder the anode. Then too finely powdered electricity carriers are prepared by taking for one carrier fine wheat flour and for the other finely powdered sulphur crystals, the wheat flour being a positive carrier and the sulphur a negative carrier. They are electrically charged by pressing them together, whereby the molecules of one substance deprive the molecules of the other substance of a number of electrons; the molecules, that is a number of them on the surface of the one substance become negative ions, while on the surface of the other substance an equal number of negative ions remains. Both powders are deposited in the atomizer and by means of air pressure sent through the condenser. The contact with the rubber hose and the walls of the atomizer tube is sufficient to charge them. After the current has flowed for a few minutes in one direction, the condenser is opened and it is found that the inner cylinder, the cathode, is covered with a fine film of wheat flour and the other cylinder, the anode, with a film of sulphur, the covering being on the outer surface of the inner cylinder and on the inner surface of the outer cylinder respectively.

In this example the electricity carriers were *visible*. There are also carriers which can not be dsicovered even with a microscope, as for instance the molecules of air. The question arises how can ions be brought into the gases; with other words, how can the ionization of gases be accomplished.

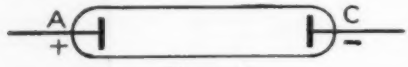


Figure 4

In Fig. 4 a glass tube is shown closed at both ends and filled with ordinary air under atmospheric pressure equal to a mercury column 760 mm. high. An electrode is inserted at each end, the anode A being connected to the positive pole of a source of current and the cathode C to the negative pole. Ordinary air being a very good insulator in an electric field of low intensity will offer a high resistance, so that no current can pass; but as soon as by means of an air pump air is pumped out, a current will commence to flow at a certain degree of vacuum, and the air (or gas) in the tube under the reduced pressure begin to be luminescent.

When the gas pressure by continued pumping has been reduced to a value equal to a column of mercury 40 mm. high, the gas will commence to become a conductor. A narrow strip of luminescence indicates the passage of the current. With increasing vacuum this strip increases in width and finally fills the space between the electrodes. Decreasing the gas pressure still further until it equals a 1/10 mm. column of mercury, the luminescence band becomes shorter and breaks up into layers of different lengths. At 1/100 mm. mercury pressure inside the tube a pencil of light of a bluish color emanates from the cathode, which illuminates the tube and produces a fluorescence of blue or green color on the opposite glass wall. The rays of this light pencil are cathode-rays, which are the electricity carriers in the case of an electric current passing through gas in a well rarefied state.

Aother example of ionization is to expose the space between the two electrodes to the action of a radio-active substance. The rays of radium or radium compounds are characterized by their faculty to split the electrically neutral molecules of the gas in the tube into positive ions and negative electrons, which are accelerated toward the cathode and anode respectively, under the influence of the electric field. Using in circuit with the tube a battery, the voltage of which is variable, and a galvanometer to observe the current, it will be found that at the beginning the current increases in proportion to the increase in voltage as indicated by the straight part of the curve in Fig. 5. At a certain point the current will not increase any more in proportion to the voltage, but at a slower rate, independent of the voltage. The highest value of the current attained is called the "saturation" current.

The current transports to the electrodes exactly the same amount of ions and electrons respectively as the radio-active substance has formed; that is, as molecules have been split. After the radio-active substance has ceased its influence and the ionization has stopped, no more current will flow, because there are no more carriers available for the electricity.

In order to transform the dependent into an independent discharge the voltage impressed on the tube must be increased to a point where the ions, some of which are always present in the tube, have obtained such an high speed, that they will loosen or entirely break up the groups of neutral gas particles consisting of ions and electrons by colliding with them. The action of a colliding electron upon a molecule or gas particle is therefore termed "ionization by collision." The parts of the neutral molecules split by this ionization will immediately migrate to the respective electrodes. On their way the ions and electrons are more and more accelerated and collide with other neutral molecules of the gas, which they split; thus the current flow is maintained as independent discharge by continued ionization by collision.

Electron Emission in High Vacuum

In a high vacuum the number of molecules and the distance between them is materially decreased so that the molecules practically do not collide with each other, but only with the walls enclosing them. A high vacuum in itself does not contain any electricity carriers and is one of the best insulators. Therefore electricity carriers have to be introduced. A very effective and convenient way of doing this is to heat the negative condenser plate or electrode or the cathode. By this process electrons will be "evaporated" from it. Electrons can freely leave the surface of a "hot" metal but cannot leave the surface of a "cold" metal. By "hot," however, is understood that the metal is glowing; below a dull red heat it is still considered "cold." In electron tubes as used in actual practice the cathode is represented by what is called the "filament," the same as in an ordinary incandescent lamp.

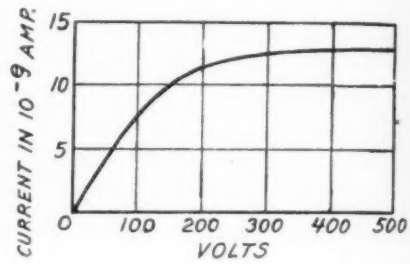


Figure 5—Saturation Current

If a current of several hundred volts is impressed on a two-electrode tube, there will be a drop in voltage from the cathode to the anode. This drop is not uniform. The greatest drop occurs in the immediate vicinity of the cathode. The fall of potential in a tube depends on the degree of vacuum. The normal fall which prevails as long as the cathode is not completely glowing, is independent of the gas and current intensity at the time, but its magnitude is influenced by the kind of gas and the material of the cathode. It may be assumed that free electrons move around between the molecules of the metal which is used as cathode (platinum, tungsten, etc.), but that the interstices between the molecules are so great in proportion to the size of the molecules that the electrons move with very high velocity. In their migration they collide, however, with a molecule or other electron, which not only retards their progress, but also renders their paths irregular. As long as the cathode is cold, the electrons will not leave the surface of the metal; but as soon as the metal of the cathode becomes hot, the velocity and force of the molecules and electrons increases and a few electrons fly out of the surface of the metal and prosecute their journey in the direction of the anode in case an electric field exists.

With a perfect vacuum in the tube the emission from the cathode represents a

pure electron current. If, however, a residue of gas is still present in the tube, an ionization by collision will accompany the electron current proper, which will assist in sustaining the current in the tube. The resulting current is depending to a great extent on the temperature and surface of the cathode and on the voltage impressed upon the tube. The gas pressure and the number of electrons set free by the ionization also exercises some influence upon the current; only the presence of an electric field will assure a continued emission from the hot cathode. If there is no electric field the electrons emanating from the cathode will return to the cathode from which they came, and fill the entire space of the tube (space charge), thereby forming a kind of counter-voltage to the electric emission. Should electrons reach the anode in spite of this counter-voltage, the current will increase only to a certain value which is the limiting value.

Ramblings

(By J. A. S.)

Yes, service improves. While in St. Louis recently our friend, C. A. Vedder of the Southwestern Bell Telephone Company in that city, tendered the writer the use of a wire to Fort Worth so that he might talk to his old home town. He suggested that we see how quick service could be secured—although the Republican national convention was in session at Kansas City and the lines were congested. One minute after picking up the receiver we had Dallas, a half a minute later we had Fort Worth and in a quarter minute we were talking to our party. That is the rule rather than the exception now, too.

* * *

Another incident that quickened our pulses recently was a phone call from our old friend (and your old friend) Ben Woodbury, for ages salesman for the Kellogg Switchboard & Supply Company, but for the past ten months one of the mainstays of the Stromberg-Carlson Telephone Manufacturing Co., Rochester. Ben is now living in Rochester, N. Y., and likes the surroundings very much, he says, but comes over to Chicago occasionally, and doesn't forget his old friends.

* * *

Had the pleasure recently of recounting old experiences with P. Kerr Higgins, former writer for Telephone Engineer and at present owner of some twenty exchanges over in Missouri. Higgins makes his home at St. Louis, but he can't be held in any place long—except at home. P. Kerr has a new slant on the cause and effect of telephone mergers, and it may be that he will furnish a few chapters on this and other subjects for Telephone Engineer some time during the latter part of the year.

* * *

Roscoe Pontius of Rochester was elected president of the Northern Indiana Telephone Association for the coming year. Pontius is "an old man" in experience but young in years, full of enthusiasm and will make that association one of the peppiest executives it has ever seen.

* * *

South Shore Inn, Lake Wawasee, Syracuse, Ind., is one of the prettiest spots in Indiana. Facing the lake and with large, roomy verandas, it affords an excellent opportunity for the tired, weary telephone man to while away three days and at the same time attend to business—his business and the public's business—by giving of his time and experience to others in the same line of business, and learn from others the things he may be inefficient in.

* * *

In presiding at the Wawasee convention, Henry Barnhart was addressed as "Senator Moses," by one of the speakers. And the speaker may not have been so far wrong after all, for Barnhart has acted the Moses in bringing the telephone business out of the wilderness in many instances with his wisdom.

* * *

Theo. Stoops of Nappanee invites the Northern Indiana Telephone Association to meet at "his home town" when the next quarterly meeting is held. Stoops has been a wheelhorse of this organization since its organization in 1913, when he acted as its first secretary. He has just retired as its president and is still an active officer in the organization.

* * *

We might rise to state that if all those who attend the conventions are to listen in on the programs, loud speakers will have to be installed on the golf courses. But it's a great game and we envy the fellows who can and do enjoy it.

* * *

Kempster B. Miller writes Telephone Engineer that he contemplates rewriting his former book, entitled "American Telephone Practice," which will doubtless be interesting news to the thousands of readers of this very interesting volume. Mr. Miller states that the entire edition will be revamped if not rewritten throughout, and will probably be issued under a different name.

* * *

W. L. Shoots, acting general manager of the Home Telephone Company of Goshen, Elkart, et. al., of Indiana, is very optimistic over the outlook for Independent telephony. Although he has disposed of his interest in the above properties, Mr. Shoots has lost none of his interest in the industry and believes that it is the best business in the world.

Chicago Bell's Fiftieth Anniversary

The fiftieth anniversary of Bell telephone service in Chicago is today (June 26).

The first Bell central office in Chicago was located on the top floor of the building at 125 La Salle street (old number), now 17 North La Salle street, opposite the Hotel La Salle. The business office was in the basement. Service opened June 26, 1878, with seventy-five telephones. The first operators were boys. The telephone instrument at that time was

Chicago Telephone Exchange of Fifty Years Ago

a clumsy affair with two telephones similar to the present receiver connected to it with cords. The user talked into one and listened with the other.

The Bell Company of Illinois was organized in December, 1878, and in January, 1879, Bernard E. Sunny, now chairman of the board of the Illinois Bell Telephone Company, became superintendent. The Chicago Telephone Company, now the Illinois Bell, was incorporated in 1881. Several other officials of the Illinois Bell started in those early days, some as boy operators. Among these are W. J. Boyd, treasurer, and W. G. Luscombe, assistant treasurer.

In its first fifty years the telephone has grown from one central office with seventy-five telephones to ninety-nine central office switchboards and 914,000 telephones. It is expected that one million will be in service by 1930. The company has 21,000 employes in Chicago, of whom about 12,000 are the young women operators.

A few miles was the limit of telephone transmission in 1878, but now not only the entire United States but Canada, Mexico, Cuba, and a large part of Europe, are within telephone reach of Chicago. In 1878 telephone wires were carried over the tops of buildings. Today, the company has more than 4,000,000 miles of wire in Chicago, the greater part of which is in underground conduits.

The company has issued an invitation to the public to visit any of the telephone offices this week between the hours of 9 a. m. and 6 p. m.

Annual Conference of Class A Companies Shows Healthy Condition of Industry

The annual conference of the Class A companies of the United States Independent Telephone Association was held at the Hotel Stevens, Chicago, June 7 and 8. Class A telephone companies are those defined by the Interstate Commerce Commission as having over $250,000 annual gross receipts from operations. There were sixty such companies members of the United States Association as of December 31, 1927. President MacKinnon, of the association, submitted an analysis of the operations of these companies filed for 1927 as compared with 1926 and 1919, showing a gain in the nine-year period from 1919 to 1927 of 57.7 per cent in number of telephones operated, and gain in investment in fixed capital of $82,000,000 in that period. The sixty companies at the end of 1927 showed an aggregate investment in fixed capital of $169,000,000, with an income available for interest and dividends after payment of taxes and all other deductions of $10,674,000.

The majority of these Class A companies were represented at the conference, the program of which culminated in a conference luncheon held on the afternoon of the eighth, to which had been invited representatives of a number of the investment houses that have lately been participating in the financing of Independent companies. At this conference striking addresses were delivered by Mr. R. F. De Voe, president of R. F. De Voe & Company of New York City, on "The Telephone Securities Market Today," and by Mr. J. G. Crane, vice-president of Theodore Gary & Company, Kansas City, on "The Conditioning and Operation of the Small Exchange After Consolidation." At this conference, too, President MacKinnon, in his opening remarks, commented upon the recent financing and the apparent disregard by some of the newcomers in the industry of the established principles and practices that the veterans of the industry had found necessary to follow. He also stated that apparently the newcomers lost sight of the fact that the telephone industry is a regulated industry by state commissions and the Interstate Commerce Commission and required to follow the practices, particularly as to accounting, laid down by those commissions. In closing Mr. MacKinnon urged that there be more opportunity for consultation between the experienced executives of the industry and the financiers who have lately come into it. "For surely," he said, "the experiences of the years must count for something. The men who have built up the telephone properties of the country certainly cannot be far wrong and the new investors certainly should benefit by those experiences and listen to the advice and adhere to the practices of these men."

Mr. De Voe in commenting on recent issues of securities said the following abuses in evidence in connection with telephone financing must be corrected:

1. Execessive valuations.
2. Failure to provide for proper depreciation. 3. Earning statements giving effect to non-recurring charges.
4. Evasive use of "Commission Approval."
5. Discrepancies in accounting.
6. Failure to represent operating conditions accurately to the public.

Mr. Crane in discussing the operation of the small exchange by a large company said in part: "The problems met with in the operation of small telephone exchanges are not materially different when the exchanges are operated individually or as a part of a group.

"By this, I do not mean to infer that there are no economies that follow properly-operated groups of telephone exchanges. I mean merely that it has been my experience that each exchange must bear its portion of the burden and must produce its own proper proportion of earnings. In other words, 'every tub must stand on its own bottom.'

"Each exchange has some one characteristic, or group of characteristics, peculiar to itself. While these same characteristics may be present in all of the exchanges, the degree to which they affect the successful operation varies from the controlling position to the negligible position. I have never found any fixed set of rules or any established procedure that will enable the telephone operating man to achieve success by applying to all exchanges.

"It has been my experience that each individual exchange must be studeid by the operating man."

In addition to this luncheon session there were two general sessions of the executives of the A class companies at which the problems of the industry were discussed in some detail and the 1927 operations as set forth in the association's compilation were analyzed. One session was a joint session of the executives of the Class A companies and the members of the board of directors of the United States Association, at which there was discussion of the relationship of the Independent group with the Bell group and the attitude of the association toward purchases of Independent companies by Bell companies. This conference voted approval of the association's stand that there should be no purchase of Independent companies by Bell companies without corresponding relinquishments by Bell companies to Independent companies.

Special sessions of the association's accounting and commercial committees were held during the conference at which the proposed revision of the accounting classifications by the Interstate Commerce Commission were discussed in detail by the accounting committee and a program for the commercial division at the annual convention in October was agreed upon by the commercial division committee.

Now Twelfth Largest Independent Company

The fact that Northern Ohio Telephone Company is now the twelfth largest independent telephone company in the United States, was revealed at the annual meeting of Class A companies held in Chicago June 7 and 8. Class A companies are those of the Independent Telephone Association with annual revenues more than a quarter of a million dollars.

Our company with the addition of the Delaware County property acquired April 1, 1928, will have annual operating revenues in excess of eight hundred thirty-five thousand dollars, placing this company twelfth in size. The growth of the Northern Ohio Company and addition of property has been a great satisfaction to us because of the opportunity thus offered to increase the efficiency of our organization and give to our subscribers and the public whom we serve a fully rounded and better telephone service.

The Tri-State Telephone and Telegraph Company of St. Paul, Minnesota and the Rochester Telephone Corporation of Rochester, New York, lead the list of Independent Companies.—News, of the Northern Ohio Telephone Company.

Canton Installs American Telephones

Canton—In rebuilding its telephone system, ruined in the orgy of destruction which marked the Communist rising of December, 1927, and its suppression, Canton has chosen the most modern American equipment. An automatic exchange with 4,000 telephones as a starter has been ordered from the United States and preliminary work has begun under the direction of American-educated Chinese engineers.

The automatic exchange is expected to be merely the nucleus of a much larger system planned to serve this city of more than 1,000,000 inhabitants as funds become available. The initial phase of installation will cost $325,000.

U. S. Independent Telephone Association Convention October 16-19, 1928

The directors of the United States Independent Telephone Association decided at a recent meeting to hold the annual convention at the Sherman hotel, Chicago, October 16, 17, 18 and 19, 1928.

LINE AND DESK

GROUND CONNECTIONS IMPORTANT

A contributor who wishes his name withheld submits the following in response to suggestions made in the editorial pages of our April issue:

In these days of metallic circuits in modern plants the ground question is not taken as seriously as it should be, and in my experience 75 per cent of grounds are of high resistance.

In dealing with a large number of small telephone companies I have laid out the following program, and in some cases I have been able to put it into effect for demonstration.

First, install at the central office two perfect grounds, but separate. Use two ground rods, groups of rods, ground plates or water works, etc., and the size of the groups or plates and the wire leading to them should be according to what has to be grounded. There should be a zero measurement between these two grounds and they should be at least ten feet apart.

Use one to ground the protectors and one for the apparatus. The protector ground should have capacity enough to carry off all energy which may be brought to the protectors by any group of wires.

Next, equip the switchboard with a plug or jack which is short circuited and well grounded. A Wheatstone bridge, Stewart detectometer or other such instrument should be used for measuring, and for small exchanges of 500 or under the latter type of instrument is economical, rapid and simple.

Then, from the subscriber's premises ask the operator to insert the plug or make connection to the jack, as the case may be. After that connect the measuring instrument between the ground and the line and record the measurement. Connect between the return and the ground and record the measurement. Measure metallic. Short circuit the line and measure.

Now, assuming the line to be composed of one mile of No. 12 iron wire and in perfect condition, the measurements will be very nearly as follows:

Line side measurement	33 ohms
Return side measurements	33 ohms
Metallic measurements	66 ohms
Short circuit measurement	16½ ohms

If the metallic measurement is much higher it will likely be found that one side measures more than the other and the line should be inspected for bad joints. If the other three measurements measure more than half or quarter of the metallic measurements the difference is the resistance of the ground.

On multi instrument lines which are equipped with condensers in series with the ringers the above measurements can be taken from any instrument on the line. Where there are no condensers in the series with the ringers the metallic measurements cannot be made, but the other measurements can be made to good advantage.

If such a method of measuring grounds is adhered to in any exchange and the ground wires made large enough to carry off all energy brought to the protectors (No. 14 wire at stations), the following results will automatically follow:

1. Reduced number of dirty carbon blocks.
2. Reduced damage to plant by lightning.
3. Improved line conditions and transmission.
4. Increased toll revenue.
5. Happy telephone men.
6. Satisfied subscribers.

Some switchboards are equipped with measuring instruments permanently connected and in such cases the operation can be reversed and the measurements read by the operator. To put such a system into operation is not difficult and most companies will be surprised at the high resistance in some of their lines. Air gap protectors at cable entrances will more than repay their cost.

As to methods of obtaining good grounds, they are diverse and sometimes very difficult but the greatest fault I have found is that men ground in a convenient place, regardless of the grade of ground. The best is not too good, even if it is hard to find, and sometimes it is necessary to carry a No. 12 iron along a few trees or poles to reach a spring or brook, but it pays in the end. Coke or charcoal buried with the ground will hold water when all around is dried out. Ground rods have a tendency to develop a coat of rust which causes high resistance and are only reliable in earth which is wet the year round.

LOCAL BATTERY TRANSMISSION IN C.B. LINES

Mr. J. P. Whitson, who has contributed many helpful suggestions to this department, now asks for a hint to help him out of some difficulty. Mr. Whitson's letter is as follows:

"Several years ago we used to cut in local batteries on some of our central battery sets where they were located out on long local lines. This was to boost the transmission from the local stations. These are Western Electric sets and I have forgotten just how this was done.

Will you kindly print sketch showing how to do this now."

The way we used to do this was to use a regular local battery telephone set without the generator and with a condenser in series with the ringer. Since the current from the central office flows through the receiver when the hook is up, it is necessary to "pole" the receiver to prevent it from being demagnetized. This is done by removing the cap and noting the pull on the diaphragm. The terminals of the receiver are then reversed and the pull again noted. The receiver is then connected so that the pull will be the stronger. Perhaps some one has a better way. If he has we will be glad to hear from him.

SOME TECHNICAL INFORMATION

In the January issue of TELEPHONE ENGINEER, W. V. Sylvester asks the question, "Why not more technical information?" In the past many of us have met men who are called experts and technicians and have wished we have had some of their knowledge. But when we have asked questions of some of these men, we have received answers which may as well have been given in Greek for all we could understand of them.

We have had people call and want to sell some new kind of instrument or equipment which they guarantee fully. We have purchased some of these articles and have finally found nothing but a bunch of trouble on our hands. The safe way is to purchase equipment from a company that is known to be reliable. There are several of these advertised in the pages of TELEPHONE ENGINEER and other journals that have been in the field for years and have proved their worth. They have efficient engineering

departments that will work with you on your wants and troubles.

Going back to the question of technical information, the writer has had many questions put up to him for which he has had to work out the answers. Perhaps the information may be of use to others and so he is giving a few of them and the answers that he has found:

Question A—How many turns of wire are there on a 1,600 ohm ringer?

Answer—If this question is asked with the view of rewinding ringer coils, the answer is that it is less expensive to buy new coils as a few short circuited turns will ruin the operation of the ringer. However, the following are the windings of standard ringers: 1,000 ohm ringers, 8,650 turns of No. 35 wire in 34 layers per spool; 1,600 ohm ringers, 10,150 turns of No. 36 wire in 40 layers per spool. Ringer efficiencies depend upon the number of turns rather than resistance. High resistance wire would give the resistance with a smaller number of turns, but the ringer would not be as good.

Question B—What are the proportions and size of wire of a good local battery induction coil for rural work?

Answer—The proportion of a good local battery induction coil is a 1 to 9 ratio of turns between primary and secondary. The primary consists of 240 turns of No. 26 S. C. C. wire put in two layers. On top of the primary is wound 2,160 turns of No. 28 S. C. C. wire.

Question C—What is the output difference of 5 and 6 bar generators and what size of wire is used.

Answer—The output of hand generators is approximately that given in the table:

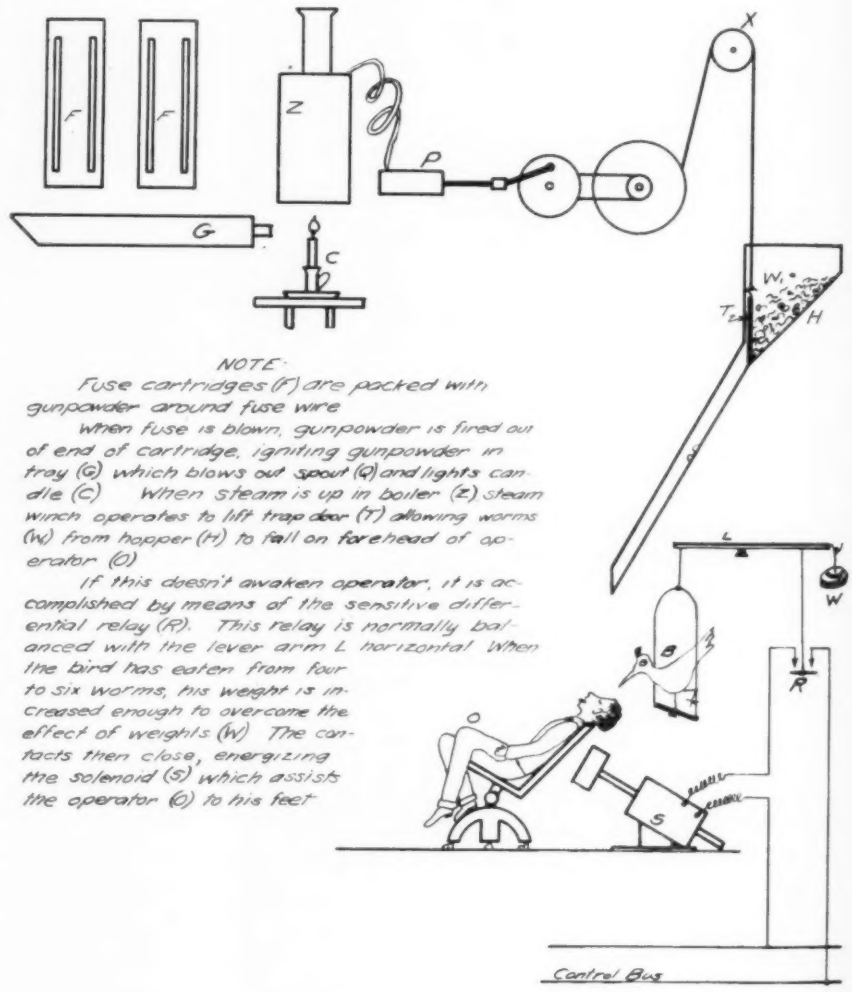
No. of bars.	Volts.	Milliamperes.	Turns of wire.	Size of wire.	Ohms.
3	65 to 90	150 to 200	3,120	No. 36 S.S.	650
4	70 to 95	250 to 300	2,640	No. 33 D.S.	330
5	75 to 110	325 to 400	1,760	No. 32 D.S.	200
6	85 to 125	400 to 475	1,400	No. 28 D.S.	140

The size of the permanent magnets, air-gap between armature and field, size and amount of iron in the armature, thickness of lamination and quality of the iron, the ratio of gears and the speed at which the armature revolves all affect the output so that the figures given may vary for different types.

These are sample questions which the writer has had to answer. He has many others which he proposes to give from time to time if they are of interest and value to others. It may be that some of the readers have questions of their own. If they will send them in he will attempt to answer them or at least is sure that some of the contributors to the Line and Desk Department can be found who can give the answer. If anyone has other answers to the questions given he will be glad to have them write in and give their ideas. — Contributed by A. Windsor McKay.

WHY WAKE THE WATCHMAN?

Several years ago, the comic sections of certain Sunday newspapers told of the inventions of Willie Westinghouse Edison Smith, who was a wonder at rigging up mechanical and electrical devices for doing extremely simple things in a most extraordinarily complicated manner. Funny page fans who have missed Willie and his inventions will be interested to note that either the original or his successor has been discovered by one of our regular contributors, W. V. Sylvester of Seattle, Washington. It seems that the surge that follows trouble in power lines induces current in parallel telephone lines that almost invariably blow the telephone fuses. An alarm circuit which indicates when the fuses are blown is desirable and so the inventor got busy with the result that he produced the design shown in the accompanying cut. We do not believe that the idea is patentable so that anyone wishing to do so may use the apparatus. But who—?



NOTE:
Fuse cartridges (F) are packed with gunpowder around fuse wire
When fuse is blown, gunpowder is fired out of end of cartridge, igniting gunpowder in tray (G) which blows out spout (Q) and lights candle (C) When steam is up in boiler (Z) steam winch operates to lift trap door (T) allowing worms (W) from hopper (H) to fall on forehead of operator (O)
If this doesn't awaken operator, it is accomplished by means of the sensitive differential relay (R). This relay is normally balanced with the lever arm L horizontal. When the bird has eaten from four to six worms, this weight is increased enough to overcome the effect of weights (W) The contacts then close, energizing the solenoid (S) which assists the operator (O) to his feet

GEOPHONES AND TELEPHONES IN MINE RESCUE WORK

Two methods of underground communication seem to promise usefulness in the establishment of systems of communication between miners entombed following mine fires and disasters and rescue parties on the surface, according to the United States Bureau of Mines, Department of Commerce, which has conducted exhaustive studies of a number of proposed methods. The two systems regarded favorably by the Bureau are, first, the geophone or earth-vibration method, and, second, the grounded-line or roof-rail conduction method of communication with telephones. All experimental work with radio gave quite negative results.

In the earth-vibration method looked upon favorably by the Bureau of Mines the transmitter is a sledge or rock and the receiver is a geophone. The simplicity and availability of the transmitter are readily conceded. The receiver (geophone) is simple, but efficient operation requires a certain degree of skill. The greatest drawback to the geophone method is that voice communication is impossible, and the use of code to any extent is difficult.

The transmitter in the roof-rail system of communication, also regarded favorably by the Bureau, is an ordinary microphone transmitter used straight or with amplification. This apparatus is fairly simple—in fact, simpler than the geophone—except possibly when amplification is used. The receiver is about the simplest of all, being only a watchcase-type telephone receiver. The wiring system inside the mine is very short, extending from the roof to the rail or floor connections. The roof connection for receiving is very simple, but for transmitting the connection has to be more extensive because the current flowing is many times that in reception. At the surface the roof-rail system requires an insulated line from the nearest available connection to the mine floor or track to a point within a radius of approximately 500 feet over the place in the mine where the underground station is located. As this line is on the surface, however, it should involve no difficulty. The roof-rail method employs either voice or code.

In these facts concerning the two possible systems of communication two things are noted: First, the system using the geophone has much the simpler transmitting apparatus, whereas the system using telephones employs the simpler receiving apparatus with relation to conditions underground. It follows that a combination of the two systems might be more practical than either alone. In such a composite system the underground transmitter would be a sledge, rock, etc., and the receiver would be a simple watchcase-type telephone receiver. The transmitter at the surface would be a telephone and the receiver a geophone possibly with amplification for both for the greater distances. The transmitter in the mine would therefore always be within reach of the entombed men, and the watchcase receiver could be incorporated in the miner's first-aid pack. This combination would allow voice one way—that is, into the mine—and rudimentary code from the mine to the surface. This should be ample for rescue purpose and much more satisfactory than code both ways.

The use of a combination method, however, would depend upon further development of these two systems of underground communication. The geophone has been developed so as to penetrate a depth of 550 feet without amplification. The few tests made with the telephonic method have shown the possibility of penetrating depths of more than 430 feet at a distance of more than 1,700 feet from the shaft with no amplification. Only enough work has been done on this latter system to indicate its possibilities.

*Rebuilding the Small Exchange**

By SAM TOMLINSON

Plymouth, Indiana

The question of *Rebuilding the Small Exchange* might be approached from the viewpoint of the physical construction, or from the most economical time from the owners' position or from the subscribers', but I am of the opinion that the question can be viewed from the subscribers' and the owners' viewpoint under the same discussion.

I believe we will all agree that a telephone plant is worth very little without subscribers. If that is true, then the subscribers must be considered and anything that is done must be figured on the basis of its effect on subscribers, as well as upon the owner of the property. One of the first questions to be decided is what amount of money can profitably be invested in the property. We all realize that it would be possible to invest so much money that it could not be made to yield a satisfactory return on the investment. This is especially true in sparsely settled communities. If rates are too high some cannot afford to keep the service, and it is also true in rural communities that houses are being abandoned and in many localities there are many fewer telephones on farms than there were some twelve years ago. Consequently, the serving of rural communities is more of a problem than it ever was, for with the increasing cost of poles, cross arms, wire and other material, we should by all means have more revenue instead of less. With our increasing costs and decreasing subscribers it surely behooves us to consider well the amount of money we will spend in rebuilding the small exchange. If we spend too much, rates will have to go up. If rates go up too much out come more telephones, and any expected increase in revenue will fall far short.

So the first thing I would do would make up my mind how much could be profitably invested. I shall assume that circumstances are such that the investment must be kept as low as possible.

I would recommend that the work be begun in the town, if town there be, and since it is along the line that we are discussing, I shall take one of our own plants, Earl Park, recently purchased by us. The town had practically no cable—all lines were grounded and were anywhere from twenty to thirty years old. Streets were filled with trees, alleys east and west, so the main cable had to run on the streets.

We secured a double mouldboard subsoil plow, hitched a tractor to it and away we went. We found that we could loosen the soil about 16 inches deep and by going twice in the same furrow we could throw most of the dirt out. The men followed with spades, taking a shallow spade deeper, which made the ditch about 26 to 28 inches deep. We threw the cable in the ditch with no protection whatever since the soil was mostly pretty sandy and in the town we have no open wire distributions at all. Cable cans within the town are non-protected, but if any open wire is to come in protected cans are used and where farm lines come into cable use, none but protected terminals and if the lightning is particularly bad, we use pole protectors ahead of the terminals. In the distribution we used at least one terminal in each block; sometimes more. No drop wire is strung over any street, consequently we were able to use 20 and 25 foot poles throughout, being careful that no limbs of trees touch the drop wire, for if they do it soon wears out. We used distribution pole brackets, on poles, and swinger knobs on the house. If necessary to set a pole to clear trees it was ordered done.

I want to answer one question that I am sure you will ask. That is, how will that kind of cable last?" To which I will say, if soil is right it will outlast aerial cable and be subject to less trouble in the small towns where there is not much digging in the streets and alleys. This type of construction is cheaper than aerial cable or open wire and has less trouble than either and is not exposed to many of vicissitudes of wires and cables up in the air. Work should be done in such manner as to cause as little trouble as possible.

On the outside there are many things to be considered, but one thing I am insisting on is that poles shall not be taken down and carted around over the exchange. If a pole can be used where it is standing, to support arms and wires, it saves labor of untieing, removing cross arms, etc. I am aware that it is the custom of many to rebuild leads with new poles and material, but if we are to get the most of revenue, then the method I propose will work out advantageously. You can readily see if poles, arms and wire are practically gone, then it is time to rebuild the whole lead and it is my idea that it should be worked up to that point if possible. Reset poles if you can keep them high enough, that the cows don't get their horns fast in the wires. Where it is absolutely necessary to place some new poles in the line and where it is

*Delivered before the Northern Indiana Telephone convention at Wawasee, June 20, 1928.

desirable to change the spacing we have on occasions made a new survey, as to locating poles, just as we would if we were going to rebuild the whole pole lead and set the new poles where they come without regard to the old poles. Looks odd, but we will get several years' service out of most of those poles, yet when we need to set a new pole we can measure from any one of the new poles and be sure that we are maintaining proper spacing of poles. Be sure to use nothing but first class arms on new poles, so that as near as may be the arms and poles will last about the same length of time. Old arms may be used on old poles.

On heavy leads where necessary to rebuild put in new poles and use the old one out on smaller, lighter leads. It does not take much of a pole to hold up two wires or even four and even though they be short, the wind has less effect on short poles than on high ones.

One point, that is of great importance in rebuilding or even in maintaining, that is guying. All guys should be made so they will "stay put." No half-way work should be allowed. Rake poles wherever you guy for the reason that if a pole once gets started over the perpendicular it then has the advantage. See that guy rods are properly aligned from the dead man to the point on the pole where guys are attached, being careful that the top of the pole is in line with the others. It will be necessary to shove the bottom of the pole out of line in order to get proper rake to poles. We have also found the use of H fixtures very strengthening to a weak pole line and in many places where it is not practical to set side guys you can use an H fixture to advantage.

I believe as a general rule I favor the gradual rebuilding where possible rather than a complete job at one time, principally because in rebuilding something each year, it is possible to get longer life out of the plant and thus keep down the amount of investment. Besides, you are able to use up the reserve for depreciation fund as it accumulates. In rebuilding, you should not only charge the cost of replacements against the fund, but also the cost of removing the old material, such as old worthless poles or stubs, taken from the ground. If you don't use your depreciation fund you are doing one of two things, either running up your maintenance cost or increasing your plant account more than it should be. Write down what is done, turn it in to your bookkeeper; it is a hard job for him to guess what you have done. Keep track of your costs; it may come in handy some time to know what certain units cost you.

There is a destiny that shapes our ends. Passing flivvers shape our fenders.—**Mink.**

Kellogg Makes Special Installation So Invalid Mother Can Hear Graduation Exercises

A recent experience of Mrs. R. W. Thorpe, of Oregon, Ill., discredits the popular belief of the heartlessness of corporations.

Paralysis had confined Mrs. Thorpe to her bed since the birth of her son Billy, nineteen years ago. For many years she had hoped to be present at the commencement exercises when Billy graduated from the Oregon High School.

Her condition at commencement time was such that it was impossible to move her. Wishing to see his wife's hopes realized if at all possible, Mr. Thorpe called a friend of many years, Mr. Leonard Bartoli, sales manager for the Fuller-Morrison Company, Chicago, to inquire if any way was known whereby the commencement exercises could be brought to his wife.

Mr. Bertoli in turn called his friend and neighbor, Mr. D. J. Gillespie, of the Kellogg Switchboard and Supply Company, and was informed that Mrs. Thorpe's wishes could be realized.

The time, however, was short and the special apparatus necessary is not generally available. The Kellogg Company was glad to supply the microphone, and detail of their sales engineers, Mr. L. Lawrence, to take care of the installation. Messrs. Jenkins and Adair, radio engineers of Chicago, courteously loaned the expensive amplifier required. The DeKalb-Ogle Telephone Company erected the necessary special line. The other three subscribers on the four-party line serving the Thorpe residence readily agreed to the line being deadened so far as telephone service was concerned during the time required for preliminary testing and during the commencement exercises.

Mr. Lawrence installed the microphone and amplifier in the Oregon Coliseum and connected them with the special line. At the Oregon exchange provision was made whereby the commencement exercises were carried to a loud speaker at Mrs. Thorpe's bedside by means of the telephone line ordinarily serving the Thorpe residence.

Thus four corporations, large and small, readily and willingly co-operated with various individuals in order that an invalid mother's hopes might be realized.

Judge C. A. Stueve Dies at Wapakoneta

Judge C. A. Stueve, of Wapakoneta, Ohio, died at his home Friday, June 15th. He had been ill for some time but his death was unexpected. He was a prominent attorney of Wapakoneta and president of the Telephone Service Company, as well as interested in other public enterprises of that place.

A Substantial Increase

Consolidated net income of the International Telephone and Telegraph Corporation and its Associated Companies for the three months ended March 31, 1928, was $3,408,374.48 as compared with $2,742,597.75 for the first quarter of 1927.

The following statement shows the consolidated income and surplus accounts for the three months ended March 31, 1928. This statement was compiled in part from preliminary and cabled reports and is subject to minor adjustments.

Consolidated Income Account

Earnings	$9,981,175.06
Operating, selling and general expenses, taxes and depreciation	5,582,096.56
Net earnings	$4,399,078.50
Deduct—Charges of Associated companies	596,954.02
Net income before deducting interest on debenture bonds	$3,802,124.48
Deduct—Interest on 4½% twenty-five year gold debenture bonds issued July 1, 1927	393,750.00
Net income	$3,408,374.48

Winona and Crown Point Companies Win Suit

The Winona and Crown Point telephone companies had finally secured permission to purchase from the Northern Indiana Telephone company properties of the latter company located at Valparaiso, Klouts, Wheeler, Hobart and Chesterton, Indiana. The Winona Telephone Company will take over the first two and the Crown Point Telephone Company will take over the three last named exchanges. This matter has been before the Indiana commission for some time, and the commission refused such permission. The case was appealed to the Lake circuit court and the decree was issued June 22.

Kentucky Exchange Rebuilding

The Taylor County Telephone Company, Campbellville, Ky., is rebuilding completely, according to reports from that place. New switchboard, cable, poles, wire and stations will be replaced and the exchange will come out in a neat spring suit. The exchange is owned by the Gainesboro Telephone Company, Gainesboro, Kentucky. An expenditure of $25,000.00 has been provided for replacement.

Kermit, Texas, to Have Exchange

Kermit, Texas, a new oil town and county seat of Winkler county, is to have telephone service. This town is located in the Panhandle of Texas, away from railroad connections and only about one year old. S. G. Smith is to install the exchange.

Telephone service, a public trust

An Advertisement of the
American Telephone and Telegraph Company

THE widespread ownership of the Bell Telephone System places an obligation on its management to guard the savings of its hundreds of thousands of stockholders.

Its responsibility for so large a part of the country's telephone service imposes an obligation that the service shall always be adequate, dependable and satisfactory to the user.

The only sound policy that will meet these obligations is to continue to furnish the best possible service at the lowest cost consistent with financial safety.

There is then in the Bell System no incentive to earn speculative or large profits. Earnings must be sufficient to assure the best possible service and the financial integrity of the business. Anything in excess of these requirements goes toward extending the service or keeping down the rates.

This is fundamental in the policy of the company.

The Bell System's ideal is the same as that of the public it serves—the most telephone service and the best, at the least cost to the user. It accepts its responsibility for a nation-wide telephone service as a public trust.

The Channell Splicing Machine New Development for Efficiency

The developments in the art of communication in the last decade have been a source of wonderment and amazement to the scientific world. The popular mind has, with difficulty, followed the procession of the marvelous advancement; long distance telephony has spread its network over the United States, Canada and Mexico, and has brought the people of these countries into close neighborly contact. The marvel of the radio broadcast with its linkage of land lines, tying the vast telephone and radio system of the country together, has become commonplace. Telephotograph and television have passed in review before the wondering public and before the mind has been able to conceive and animate these scientific miracles, the bridging of the gap between the old world and the new, by radio telephone, has been spread before the world and become a matter of our daily routine.

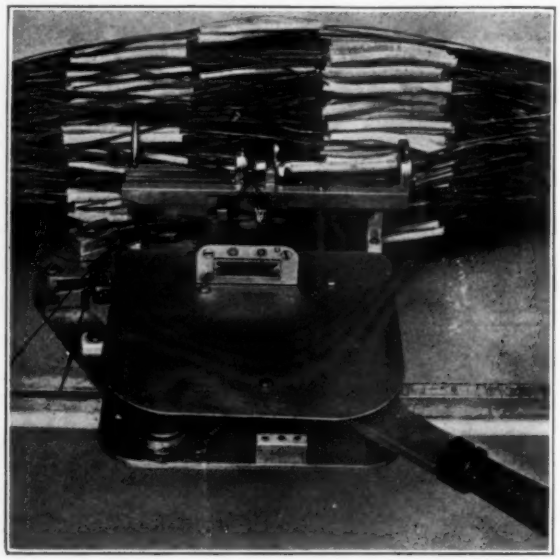
The realization of the wonderful advances in this commercial and scientific art has long been the inspiration of many inventors to devise methods, apparatus and equipment to carry on the work in a better and more economical manner. The vast amount of underground and aerial cable plant in use throughout the telephone systems of the country brought that inspiration to Mr. J. W. Channell, the father of machine cable splicing.

To those who are familiar with the telephone industry, it is well known that ever since the advent of cable into telephone practice, the work of joining the wires into a continuous circuit has been performed by highly trained, skilled and expert workmen known as cablesplicers.

Who among you has not stood over a manhole and watched the dextrous fingers of these men, working with lightning like rapidity, joining together the nerve system of the nation?

Mr. Channell was among the most expert of these men and as he sat for hours working on the great cables the thought came to him that this work could be better and more efficiently done by machine. Thoughts of the linotype, the knitting machine and all the wonderful developments of industry flashed through his mind many times as he sat at his daily labor.

After months of patient experiment with many failures, he at last evolved out of clock wheels, bits of springs and other odds and ends found in the work shop of an inventive genius, the first splicing machine. In all its crudity it contained the essential principles which later found place in the perfected instrument which is the marvel of all the construction specialists of the telephone industry.



Model "C" Channell Splicing Machine, which, it is claimed, will speed up work

It is said this instrument is so simply constructed, so compact and light, that it may be carried in hand tool box from job to job.

The simplicity and ease of operation is such that an untrained man with a short training period of from ten days to two weeks is able to splice the most difficult cable in a better, more uniform and more workmanlike manner than the most expert hand splicer.

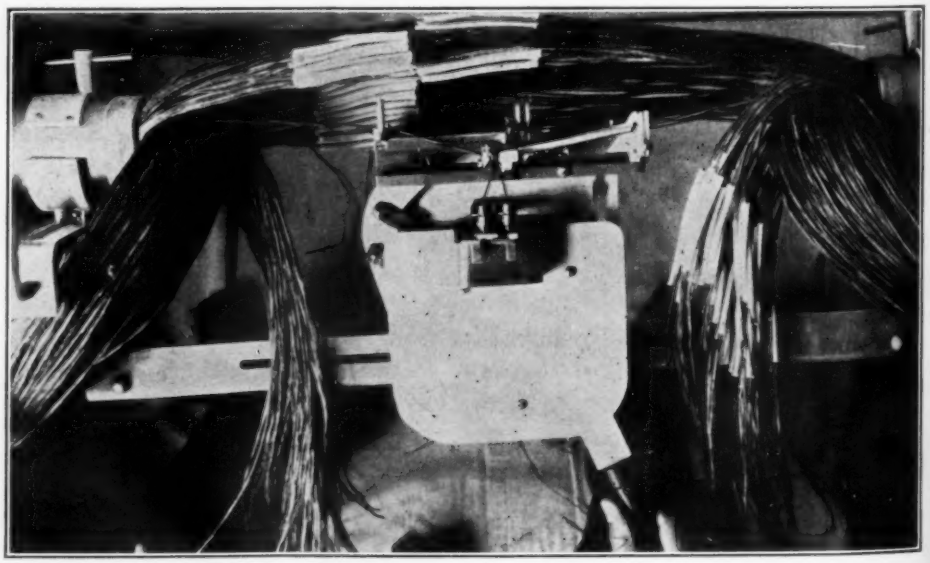
If this were the only advantage of the machine splicing over the hand splicing it would be considered a wonderful advancement in the art, but in addition the machine has repeatedly demonstrated that it will perform the work in one-half of the time of that required by hand splicing. An inexperienced man with only ten days' training made seven 1212 pair straight splices with an average of seven hours and six minutes per splice. Two 1212 pair multiple splices with 404 pair stubs in eight hours and fifteen minutes each. A record of four hours and thirty-one minutes has been made for 1212 pair straight splice.

The record for 1212 pair multiple splice with 404 pair stub is five hours and twenty-three minutes. All records include total elapsed time of splicing the wires.

The machine is made throughout of duralumin with the exception of wearing parts. The splicing unit weighs only five and one-half pounds and the carriage four and one-half pounds, making a total net weight of ten pounds.

One of the greatest developments in the work of the splicing machine is the "Special Channell Twist." Through the action of the twisting elements of the machine, the wires are twisted in such a manner that they make a perfect electrical contact and will not slip in rough handling, as in hand splices. The wires can be pulled apart and transferred if necessary.

The machine makes all kinds of splices,



When handle is moved to left, third operation cuts off pair, twists pair, cuts off end of spliced wire, turns over splice, slides sleeve over splices and throws pair out of machine.

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USE MORE
PATENT ANCHORS
CHANCE MAKE BETTER ANCHORS POLE LINES
A Type and Size To Meet Every Need
Specify CHANCE ANCHORS Your Jobber Will Supply you
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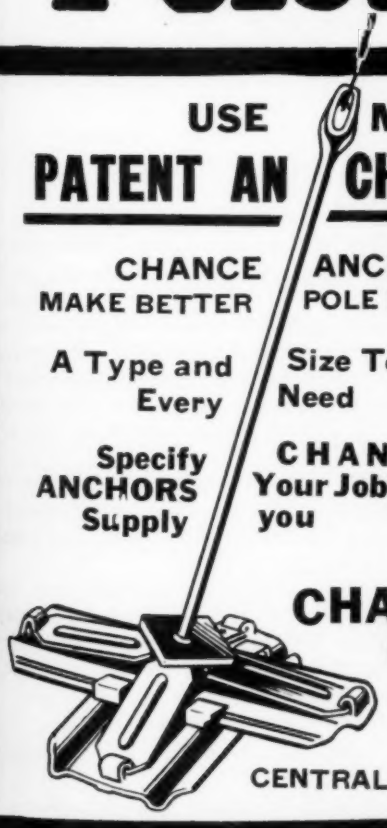
CENTRALIA, MO.



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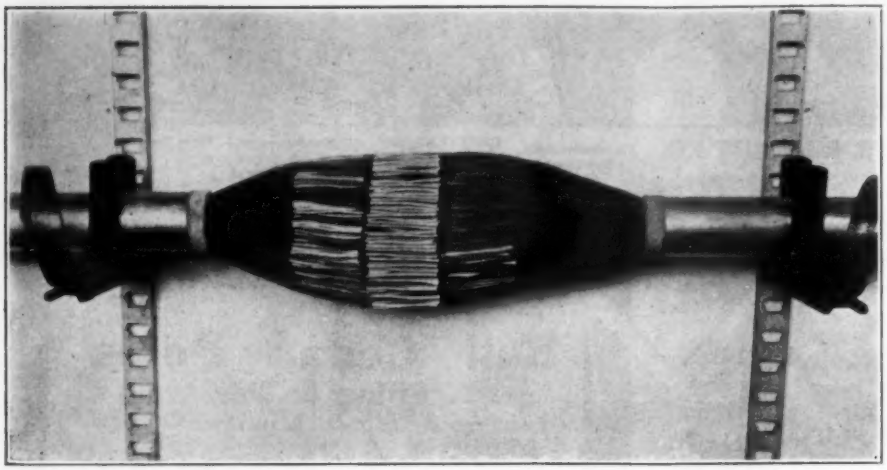
ZINC CHLORIDE TREATED LUMBER
W. C. MEREDITH CO. Atlanta, Ga.



1212X *straight splice, made with Model "C" machine; time, 4 hours and 31 minutes.*

straight, multiple, and butt in a uniform neat and workmanlike manner.

This machine is particularly adapted to the splicing of the latest type small gauge cables, which have recently been developed. Up to the present time cable has been manufactured of twenty-two and twenty-four gauge wire for exchange use. It is extremely difficult to hand-splice smaller sizes than 24 gauge. With the Channell machine perfect splices are made in 26 and 27 gauge wires. These machines are manufactured by the Channell Splicing Machine, 8147 Seville avenue, Southgate, California, J. W. Channell, president.

The Ernst Rosenberg and Company, Genthiner Str., 38 Berlin, Germany, has taken over the sales and distribution of the Channell machine in European countries. Through the efforts of Mr. Channell the telephone industry has a machine which will increase the efficiency of its construction forces, make better and more uniform cable splices both mechanically and electrically, and take a step ahead in the advancement of the art.

Passing of Alfred Rosling Bennett

It is with regret that we announce the death of Mr. Alfred Rosling Bennett, M. I. E. E., M. I. Loco E., which took place at Matlock, England, on May 24th, 1928. The late Mr. Bennett was born in 1850 and was a prominent figure in the early days of telephone history.

For many years Mr. Bennett was engaged in Telephone and Telegraph research work. In 1869 he went to the Orient and spent four years on telegraphic work in India, Persia and Turkey. In 1881 he invented a cheap form of primary cell and in 1877 he erected the first external telephone circuit ever used in England. In 1880 he became the Superintendent Engineer for the United Telephone Company, Ltd., and in 1881 he accepted the post of Chief Engineer of the Glasgow Commercial Telephone Company. From 1882-1890 Mr. Bennett was General Manager and Chief Engineer of the National Telephone Company, Ltd., for Scotland, Cumberland and Westmoreland. Subsequently he was General Manager and Chief Engineer of the Mutual Telephone Company and the New Telephone Company, and he designed and installed telephone systems in London, various provincial towns and the Channel Islands. In 1897 he visited the United States and amongst other matters inspected the automatic exchanges of the Strowger system and reported strongly in their favor, predicting that this system would be capable of dealing with exchanges of 10,000 lines.

Mr. A. R. Bennett invented several types of exchange switchboards, a primary cell, the telephonic repeater and the well known insulator which bears his name.

He originated the Edinburgh International Electrical Engineering Exhibition held in 1890 in which connection he served as Vice-Chairman of the Executive Council.

In addition to his telephone work Mr. Bennett was a well known power engineer, locomotive engineer and author. As a power engineer he directed the first installation of the incandescent lamp in Scotland, and the electric lighting of the first coal mine ever lighted by electricity in the world. He was recognized as an authority on locomotives and was elected vice-president of the Institution of Locomotive Engineers (England) in 1911.

Besides his contributions to the press and his papers on technical subjects, Mr. Bennett was the author of many works of which the best known are the following: "The Telephone Systems of the Continent of Europe," "Proposals for London Improvements," "Historic Locomotives," "First Railway in London," "A Sage of Guernsey," "London and Londoners in the Eighteen-Fifties and Sixties," "Chronicles of Boulton's Siding," and "The History of the State of Guernsey Telephone System."

In later years Mr. Bennett had been acting in a consulting capacity to various firms and municipalities. He had a large circle of friends in many countries and his demise will be recorded with regret by a large number of people.

Mr. Bennett was an uncle of H. S. Bennett, an engineer occupying an important position with one of the Theodore Gary organizations in London.

Conversion of Automatic of New Haven Exchange of the Home Telephone & Telegraph Co.

Announcement recently was made by Mr. Frank E. Bohn, president and general manager of The Home Telephone and Telegraph Company of Fort Wayne, Indiana, that the New Heven Exchange, owned by that company, now operated under the mutual system will be converted into the automatic or dial system, effective December 1.

The order for the automatic equipment has been placed with the Automatic Electric Company of Chicago. The entire cost of the equipment, outside rehabilitation and other rearrangements which will be necessary, will amount to approximately $60,000.00.

The installation will start with 200 lines with a capacity for 500. A distribution system and additional circuits to Fort Wayne to care for the maintenance and operation of the automatic lines will be installed. Exchange boundaries and standing toll charges will remain the same.

Heads Theodore Gary & Company

H. L. Gary was recently elected president of Theodore Gary & Co., succeeding A. F. Adams. Mr. Gary has been connected with the company for many years and his promotion comes as a reward for the interest shown and ability demonstrated while in the organization.

A. F. Adams becomes chairman of the board of directors, and Theodore Gary chairman of the executive committee.

Through Diversified Investment Co. and other companies, Theodore Gary & Co. operates many independent telephone properties in the United States and in foreign countries.

"Did you see the Tuilleries when you were in Paris?"

"Well, we called, but they weren't in."—Wisconsin Octopus.

HERE MR. SECRETARY IS THE ANSWER OF ONE INDUSTRY

No. 1 of a series inspired by the report of Secretary Hoover's Committee On Elimination of Waste.

MEETING THE STANDARDS OF AN AUTHORITY

The business world has come to look upon the report of Secretary Hoover's Committee on the Elimination of Waste in Industry as an epochal document.

Were Western Electric to put into words its own economic creed it would be but following out the principles stressed in that great contribution to industrial progress.

This company, as makers of the nation's telephone equipment, has long made it a practice to plan its manufacturing so as to reduce to a minimum time required for production, to level off the ups and downs of factory operation, to standardize its purchasing through simplification, to inspect and reinspect materials, methods and equipment, and to distribute at minimum cost.

In these and other ways, Western Electric has sought to measure up to its three-fold responsibility as purchasers, manufacturers, and distributors for the Bell System.

Western Electric

Purchasers... Manufacturers... Distributors

SINCE 1882 FOR THE BELL SYSTEM

Elementary Principles of Radio

By D. H. MINER

In 1888 Heinrich Hertz discovered and measured electric waves or, as we now know them, radio waves. These radio waves we now know to be the same in nature as those we call ultra-violet, infra-red, X-rays and the visible waves which we recognize as the colors of the rainbow. All the waves mentioned travel through ether at the same speed, approximately 300,000,000 meters per second. The various waves do differ from one another in wave length. The longest visible ether wave, that of red light, is about eighty millionths of a centimeter in length. (One inch equals 2.54 centimeters). The X-ray and the ultra-violet rays are much shorter than this. The infra-red rays are somewhat longer than the visible red, and the radio waves are very much longer, some of the commercial stations using wave lengths around 600 meters. (A meter is about three and one-third inches longer than a yard).

Since the speed of these ether waves is a constant a very simple equation can be written involving the speed, frequency and wave length. The equation is as follows: $V = NL$, when V equals the speed, N equals the frequency in cycles per second and L is the wave length. By this equation it will be seen that the wave length can be determined by dividing 300,000,000 by the frequency of the broadcasting station and the result will be in meters.

The writer assumes that the reader is familiar with the action of telephone transmitters and the way they respond to sound waves along with the resulting modulations of the direct current through the transmitter. He also assumes that the reader is familiar with the fact that the negatively charged particles, the electrons, are attracted to positively charged objects. The reader should also be familiar with condensers and a few other simple electrical devices.

In beginning our discussions let us consider the case of a broadcasting station to which the radio commission has assigned a wave length of 300 meters. From the above equation we see that such a station sends out waves that have a frequency of 1,000,000 cycles per second. At this point it must be understood that the human ear can not hear frequencies much above fifteen or twenty thousand cycles or vibrations per second. Middle C is a frequency of about 256 vibrations per second. It may, therefore, be of interest to the reader to consider for the next few paragraphs how waves of such high frequency can bring to us the audible tones.

The microphone of the radio transmitting station is essentially the same as a telephone transmitter except that instead of having a low voltage, direct current passing through, it has a high voltage, high frequency current. As one speaks into the microphone these electrical vibrations are changed in amplitude but not in frequency and therefore not in wave length. These modulated radio frequency oscillations cause corresponding waves to be sent out from the aerial.

Let us now turn our attention to the radio vacuum tube. Its essential parts are the filament, grid and plate. When in use the filament is kept hot by a current from a low voltage battery called the A-Battery. When this filament is hot it readily gives off electrons to any positive object that may be near. The plate, as its name suggests, is a large metal surface which is kept positively charged by a high voltage battery called the B-Battery. Between the filament and the plate is the grid, resembling a wire netting. When the grid is positively charged it helps to draw off the electrons from the filament, and when negatively charged it tends to keep the electrons from getting to the plate.

At the receiving station a current is induced in the aerial that has the same frequency and the same modulations as those oscillations in the microphone of the sending station. This current comes down the aerial wire through the receiving set and then to the earth. As it passes through the receiving set it actuates a step-up transformer. One of the leads from the secondary of this transformer passes to the grid of the vacuum tube. Accordingly this grid is charged positively and negatively as the current in the aerial oscillates. The result is that the electrons or the current from the filament to the plate is modulated in the same way as the ether waves coming from the sending station. This modulated plate current may then be passed through the primary of another step up transformer producing modulation in the plate current of a second vacuum tube. This may be done several times; each time the signal becomes more intense. In the first two or three stages of amplification just mentioned the transformers may not have iron cores and therefore they permit the passage of the very high frequency oscillations due to the small amount of impedance. In the last couple of stages the transformers may have iron cores. The result is that the high frequency radio waves are choked out but the modulations of the audible frequencies can still pass through to activate the secondary of the transformers. This finally modulated current of audible frequency is passed through the head phones or loud speaker and the sound waves emerge having the same pitch and quality as those sound waves that produced the modulation of the high frequency current through the microphone of the sending station.

All of this would be very simple if there were only one station broadcasting the waves to our aerials. But since there are many such stations it becomes necessary to devise some method of bringing the stations we desire and excluding those we do not desire.

If two tuning forks of the same frequency be placed on a table and one be set into vibration, the sound waves of the first will set the other to vibrating. This will not be true unless both forks have the same natural frequency of vibration. Likewise it becomes necessary to make our receiving sets have the same natural frequency as the sending station desired. This resonance can be obtained by placing condensers and coils in suitable places in the radio frequency amplification stages mentioned above. Therefore when we wish to tune out one station and tune in another we simply turn the dial or dials that change the condensers and determine the frequency that shall produce resonance in the receiving set.

The discussion of the various types of receiving sets and the technique of broadcasting must necessarily be reserved for a more technical discussion.

Chicago Utility Concern Buys Telephone Exchanges

Telephone exchanges at Panama, Okla., and at Hackett and Greenwood, Ark., owned by A. A. Sampson of Panama, have been sold to the Southwestern States Utility company of Chicago. It is said that this company is also negotiating for purchase of the telephone systems at McCurtain, Keota, Kinta, Quinton and Porum.

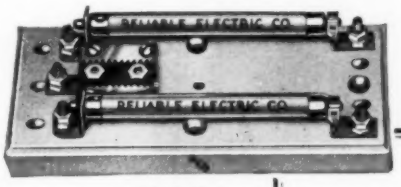
Snook-Martin & Co. New Engineering Firm

The firm of Snook-Hillhouse & Co. was recently dissolved, Mr. Hillhouse retiring from the firm. The style of the new firm is Snook-Martin & Co., and composed of Ward H. Snook and George Martin, and are located at 40 West Gay street, Columbus, Ohio. This firm is recognized as one of the leading consulting engineering firms in the country.

Reliable

Individual Station Arresters

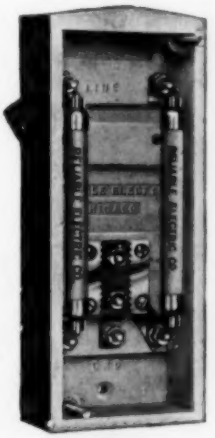
Listed as standard by Underwriters' Laboratories



998-C

All arresters illustrated are of self-cleaning type used by many of the largest telephone companies.

The sawtooth type of protection eliminates dirty carbon troubles — lessens interruptions to service! Not new idea. Field service verifies all our claims.



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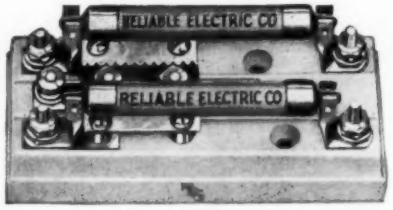

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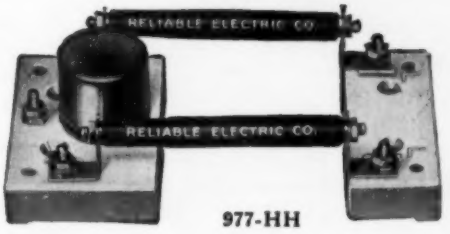


977-HH

Reliable Electric Company

3145 Carroll Avenue Chicago, Illinois

With The Manufacturers

New Anchor Marketed by Jas. R. Kearney Corporation

James R. Kearney Corporation, 4224-32 Clayton avenue, St. Louis, Mo., manufacturers of overhead and underground utility equipment, announces the manufacturing and marketing of Kearney Hi-Tension 4-in-1 Expansion Anchors.

According to the manufacturer, these anchors are suitable for use in any kind of hard soil, at any angle, to any depth, and in any location.

They are manufactured in four sizes, 6, 7, 8 and 10 inches. These anchors are made of certified malleable iron guaranteed against breakage.

The New Kearney Anchor Ready to Place in Ground

The particular features incorporated in this anchor are: That this anchor can be used as an expanding anchor, as a plate anchor, as a cone anchor, and as a metal slug anchor. It expands to 2½ times its rated size: For example, the 6 inch anchor expands to 15 inches, 7 inch to 17½ inches, 8 inch to 20 inches and 10 inch to 25 inches.

This anchor is the only expansion anchor made which gives a compression of earth when expanded. The anchor blades are pitched slightly downward. This expansion is absolutely positive. When once expanded, the anchor becomes permanently locked in its open position.

New Kearney Anchor Expanded

The manufacturer recommends that this ancher be set horizontal as in this manner it pulls against the same strata of undisturbed earth.

The blades of the anchor are supported by ribs which give the anchor greater strength. The disc at the bottom of the anchor is so designed that it fits snugly under the expanded blades giving a permanent locking device. There is no danger of the blades refusing to open when the anchor is being installed as the tamping bar opens the blades simultaneously as it strikes them. A standard steel guy anchor rod is used with these anchors. The anchor rod is removable for salvage purposes when desired.

According to the manufacturer, the 6 inch anchor is recommended for holding power of 12,000 pounds in hard pan, 7 inch anchor 16,000 pounds, 8 inch anchor 20,000 pounds and the 10 inch anchor 30,000 pounds. Bulletin No. 301 covering Kearney Hi-Tension 4-in-1 Expansion Anchors will be sent upon request.

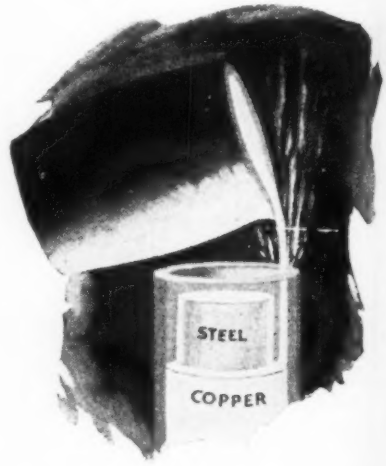
Copperweld Wire Now Used for Fence

After an extended period of actual test service, laboratory experimentation and field research, Copperweld wire is now to be used as a material for residential, industrial and institutional fences, according to a recent announcement issued by the Copperweld Steel Company of Glassport, Pa. This new type of fence, which is to be had in both "ornamental" and "chain link" constructions, is to be distributed through the Page Fence Association of Chicago.

In Copperweld fence a thick layer of ductile copper is molten welded to a steel core. This is done by heating a steel billet to a welding, white-hot heat, after which it is surrounded with a layer of molten copper. The manufacturing process is illustrated, in principle, by the accompanying drawing which shows the operation of pouring the molten copper around the white-hot steel billet that has been centered in a graphite mold.

Ordinarily this round steel billet is 7 inches in diameter and 48 inches long. After having been thoroughly cleansed and fluxed, the steel billet is centered in a mold with uniform spacing on every side. This mold is then sealed and placed in a furnace where both are heated until the surface of the unoxidized steel reaches its melting point.

Molten copper is then poured into the mold, filling the space between the white-hot billet and the inner wall of the mold. This liquid copper, coming into contact with the liquid surface of the steel, forms an absolute continuous weld, which it is claimed neither bending, twisting, hot-rolling, cold-drawing, forging or sudden temperature changes will destroy.



This Copperweld ingot, which is now 9 inches in diameter, is first hot-rolled into a rod ⅜ inch in diameter, after which it is cold-drawn into wire of the required size. The combination copper and steel ingot rolls and draws as one metal, the original proportion of copper and steel remaining the same through all stages of fabrication.

Several features are claimed for this type of wire. For instance, it is asserted that the welded copper exterior affords almost indefinite life to the wire by reason of its rust-resisting qualities. Permanence is a most desirable feature in fence, particularly in industrial districts where the atmosphere is laden with corrosive elements. Another interesting point made for this wire is that it can

Four for Two is the HAYES Rate for You!

$4.00 FOR TWO No Higher

HAYES HOTEL NORTH

420 Diversey Parkway
at Lincoln Park
CHICAGO

OPPOSITE the famous Lincoln Park where you may enjoy golf, bathing, boating, tennis, riding and many other sports--only 12 minutes to "loop"--all north bound busses pass our door.

Every room with bath

Rates
Single —$2.50 to $3.00
Double—$3.50 to $4.00
NO HIGHER

Attractive Weekly Rates

Also operating
HAYES HOTEL SOUTH
64th at University Ave.

John Hayes Frank Hayes

Write for booklet

A Controlled Flame

Prest-O-Lite Blow-torches, which use Prest-O-Lite Gas only, supply a flame that is always under perfect control. Heat can be applied exactly where you want it. Even the most delicate connections can be soldered without injury to the adjacent parts.

There is a Prest-O-Lite Torch for every soldering or heating purpose. Telephone companies everywhere use Prest-O-Lite equipment for lineman's work and in the shop as well. Most of the larger utilities have standardized on Prest-O-Lite.

Ask the Prest-O-Lite distributor about this equipment, or write us direct for complete information.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide & Carbon Corporation
UCC
New York Indianapolis Chicago San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd., Toronto, Ontario

Prest-O-Lite GAS

be colored to any desired shade of green, or brown, merely through the application of acids. The possibility of tinting a permanent fence lends esthetic value to an otherwise ordinary product that would appeal to many property owners.

You Should Have Matthews Bulletin No. 502

W. N. Matthews Corporation, St. Louis, Mo., want to send you Bulletin No. 502, if you are interested in Fuswitches and Disconnecting Switches. Drop them a post card and the bulletin will be forthcoming.

They are stressing their new open type for rural and farm lighting.

To meet the demand for a low cost Fuswitch of high rupturing capacity for rural and farm lighting lines, we have developed the 1317 Open Type Matthews Fuswitch. It is vertical in design and is equipped with the patented double tube Vacuum Fuse Cartridge. If you need such a switch send for special bulletin.

New Bulletin on Ground Resistance Measurements

A new bulletin designated as Technical Bulletin 1185 has been issued by James G. Biddle, dealer in electrical and scientific instruments, Philadelphia, Pa. This bulletin deals with the measurement of the resistance to earth of ground connections. A description of a new direct-reading "Megger" ground resistance tester is given and comparisons of various methods of tests and data on the characteristics of earth are included.

Albert Parlett, Jr., Joins the Kellogg Company

The Kellogg Switchboard & Supply Company announces the addition to their sales department of Mr. Albert Parlett, Jr.

Mr. Parlett has gained a thorough knowledge of the telephone industry through his years of work in the operating field. He was literally born into the independent Telephone Industry. His father founded the first independent telephone exchange in his home town of Bristol, Tenn. With this exchange as a nucleus Mr. Parlett, Sr., built around it one of the most progressive and efficient telephone organizations the industry has known.

Upon graduating from Washington and Lee University in 1912, Mr. Parlett, Jr., became actively engaged in the operating field with the Bristol Telephone Company.

In 1915 he came to Chicago to make an intensive study of telephone manufacturing methods. When he returned to Bristol late in 1915 Mr. Parlett, Jr., assumed the duties of assistant secretary and engineer for the Bristol Telephone Company.

In 1921 the Bell properties consolidated with the Bristol Telephone Company and the Inter-Mountain Telephone Company was formed. Mr. Parlett, Jr., was elected secretary and treasurer and held that position until his retirement from the telephone industry in 1925.

Albert Parlett, Jr.

While resting at Spruce Pine, N. C., he decided to open an electrical store, which prospered under his able guidance.

Mr. Parlett's heritage and experience, coupled with an unlimited amount of engineering ability and aggressiveness, will be of great assistance to the Kellogg Company in better serving its customers.

Mereduc Conduit

"Mereduc" conduits are manufactured from selected Southern Pines, treated with the best grade of Creosote, 15 lbs. to the cubic foot, giving an average life of 50 years. They can be furnished in single ducts or in any multiple desired to meet your requirements.

They are made up in the multiples that are required to meet your specifications and are banded together with a heavy spelter galvanized wire and are shipped ready for installation (single ducts are fastened with good grade staples) or where they are to be installed on wiring already down they are fastened with staples so that the top and filler may be removed for installing and are banded afterwards.

The single ducts have mortised and tennoned joints, the multiples are finished with smooth joints and wrapped with burlap and coated with pitch to give a finished installation.

"Mereduc" conduits can be installed with the minimum labor, and effect a saving in time on account of the longer lengths and smooth bore, enabling the cable to be pulled through without the use of lubricants, eliminating 50 per cent of the manholes where conditions permit.

They can be opened for repairs at any point, and multiples can be changed either up or down at any time, without special tools or skilled labor.

They cannot be affected by gas explosion, and the borer cannot live in creosoted wood.

They weigh less and show a large saving on freight and handling charges, and are unbreakable.

There is no maintenance charge in the life of the conduit which is fifty years.

The single duct conduit is the ideal installation for white ways, and the most modern, economical manner of carrying light and power lines into residences, where post and unsightly overhead wires are a detriment.

Further information may be secured by writing the W. C. Meredith Co., Station A, Atlanta, Ga.

Says Merger Impossible

David Sarnoff, vice-president of Radio Corporation, said merger between the Radio Corporation and International Telephone & Telegraph or the Western Union Telegraph Co. was impossible under the ruling laid down by the Radio Regulatory commission appointed by law which emphatically states that a radio company shall not combine activities with a telegraph company or a cable company. Mr. Sarnoff implied that this was the only obstalce in the way of such a merger and declared, this situation must be cleared up for the benefit of the radio industry and telegraph companies in this country.

S. A. Lane Purchases Arkansas Property

S. A. Lane of Litle Rock, formerly general manager of the Southwest Telephone company, operating in Arkansas, Texas and Oklahoma, recently purchased control of the Johnson County Telephone company, with exchanges at Clarksville, Hartman, Lamar and Coal Hill. He also controls The Citizens Telephone company, operating exchanges at Paris, Subiaco, Scranton, Prairie View, New Blaine, Ratcliff, Branch, Charleston and Booneville, all in Arkansas.

Officers of Indiana Association Named at Directors' Meeting

At a meeting of the directors of the Indiana Telephone Association held at Wawasee, Ind., during the convention of the Northern Indiana Telephone Association, the following officers were elected:

President, Henry A. Barnhart, Rochester.

Vice-President, W. L. Shoots, Goshen.

Secretary-Treasurer, H. L. Beck, Indianapolis.

Here and There in the Telephone Field

A. T. & T. stock took a flight around June 1st and "went over the top" for above $200 per share. It has settled down again, however, and is around $175 to $180.

The Laredo Southeastern Telephone Company recently took over the property of the Riley Telephone Co., of Lytle, Texas, and Miss Ethyl Meister is its new manager.

Otis F. Glenn, republican nominee of Illinois for the United States senate, recently bought several telephone exchanges in that state. Glenn is president of the Mid-Continent Telephone Company, which company now controls some 4,000 stations.

Increases in rates are asked in Illinois by the DeKalb-Olga, Byron and Automatic Home Telephone companies.

The city of Detroit has more than 100,000 telephones now than it did four years ago. This is a fair index of the rapid growth of that city, according to the chamber of commerce of that city.

The Standard Telephone Company recently acquired control of the Interstate Utilities Company, operating in Washington, Idaho and Western Montana; the consideration was $1,000,000.

The Bell Telephone interests are fighting "wire tapping" by dry officers in the persuit of their duties of apprehending offenders of the prohibition laws. This has always been considered legitimate but recently a federal court ruled that such officers had no such rights, hence the telephone company holds it has a right to protect its subscribers.

The Midland Telephone Company of Marshall, Oklahoma, has recently rebuilt its exchange in anticipation of the growth of that thriving municipality.

Subscribers to telephone service in the good old U. S. A. should congratulate themselves that they only have to pay $3.50 for installation of phones. In Japan the installation fee is $500; Japan telephones are government owned.

Fred Brengman, a recent graduate of Purdue University, has been appointed manager of the Eureka Telephone Company of Corydon, Ind., to succeed Geo. Miller. Brengman is considered well equipped to perform the duties of manager of that property.

The Gulf States Telephone Company, with headquarters at Tyler, Texas, is expending $3,000 to extend its rural lines in the vicinity of Troup, Texas.

The Preble Telephone Company of Preble, Indiana, has succeeded in securing a boost of 25 cents per month from its non-member subscribers. This is a small organization to furnish service for convenience; an additional charge of 25 cents per month was permitted as a penalty if service charges were not paid by certain date.

Henry Gibson of New Lisbon has acquired the interest of Edward Schoot in the Necedeh (Wis.) Telephone Company and has assumed control.

It is estimated that Southwestern Bell Telephone Company spent near a quarter million dollars to improve service in and around Houston, Texas, prior to the opening of the democratic national convention.

The Cass County Telephone Company of Harrisonville, Ark., put on a window display recently that attracted considerable attention. It consisted of telephone equipment used thirty and forty years ago, along with modern equipment.

It is unusual to talk about snow storms now, but the Liberty Center Telephone Company, over in Indiana, recently announced that it has finally completed repairs of its line caused by the sleet storms of late spring.

W. O. Mills of Hominy, Oklahoma, and assistant general manager of the Oklahoma Telephone Company, has resigned to become general manager of the Standard Telephone Company in Oklahoma. This company owns and operates twenty-seven exchanges in Oklahoma.

The Farmers' and Merchants' Telephone Company of Minerva and Paris, Ohio, has been purchased by the Standard Public Service Company of New York, for approximately $100,000, according to a recent announcement.

Hotel Empire

BROADWAY at SIXTY-THIRD ST.,
NEW YORK CITY

A New Fourteen Story Fireproof Structure Containing the latest in Furnishings and Equipment.

Capacity 1034

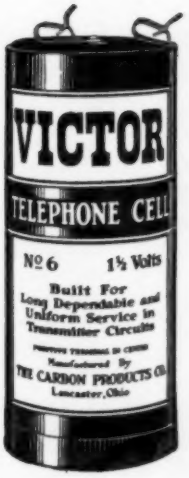
The Location is Unique in the Heart of the Automobile District, with Subway, Elevated Street Cars. Busses---all at door.

RATES

Room, Private Toilet - - -	$2.50
Single Room with Bath - -	3.50
Double Room with Bath - -	5.00

M. P. MURTHA, General Manager *Ample Parking Space*

VICTOR TELEPHONE CELLS



Uniform quality assures to you a lower average in replacement cost.

The Carbon Products Co
LANCASTER, OHIO

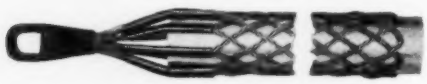
11 South La Salle Street, Chicago

Kellems Products, Inc., Offers New Cable Grip

The Kellems Products, Incorporated, 6 Varick street, New York City, is offering the telephone industry a new cable grip which they claim has many advantages over those now on the market.

Following are some of the special features claimed for the Kellems grip:

The weave in the Kellems grip is reversed, the wires terminating in a solid steel eye. This obviates all twisted and soldered ends—giving you a grip that is easily attached and removing the annoyance and danger from loose or frayed wires. Also you will appreciate the fact that this grip need never be taped as it grips to the very end. The endless weave gives greater flexibility to the grip.



The shoulder of the grip is the point of greatest wear. Therefore it is the weakest point on any grip—the trouble point. But in the *Kellems* grip it is made the strongest part—for here the strands are protected and reinforced by the Kellems tubing. Not only does this tubing protect but it reduces friction in the duct and makes the pulling job easier. And in overhead pulling it presents a smooth bearing surface and prevents crowding or displacing the cable rings. The tubes are an integral part of the grip.

Further information may be had concerning this grip by addressing the Kellems Products, Incorporated, 6 Varick street, New York, N. Y.

John F. Jaap Back on the Job

John F. Jaap, advertising manager of the Cook Electric Company, is recovering from an attack of appendicitis. He underwent an operation and was confined to his home for several weeks. He says he is now "hitting on five" and will be at his usual gait in a few weeks.

Brownwood Company Is Sold

Announcement was made in Texarkana Saturday that the West Texas Telephone company of Brownwood, Texas, has been purchased by the Southwest Telephone company of Arkansas, with headquarters at Little Rock, for a consideration of $2,150,000. The Brownwood company has plants at Brownwood, Coleman and a number of smaller towns.

A shield to prevent the juice spattering when grape fruit is being eaten has been patented by a resident of Brooklyn, N. Y.

PREVENTIVE MAINTENANCE OF AERIAL CABLE

Aerial cable maintenance is perhaps the most difficult with which we have to contend. Aerial cable is exposed to a variety of hazards and its freedom from trouble largely depends on the quality of the initial construction and the maintenance performed thereafter. The maintenance items of vital importance are as follows:

(1) Replacement of defective messenger, rings and ties.

(2) Replacement of slipped cable rings.

(3) Cutting out slack or spreading it over the adjacent span.

(4) Placing proper tree guards to prevent damage by tree limbs; however it is preferable to trim trees where possible.

(5) Placing or re-spacing trolley guards.

(6) Re-clamping terminal stubs where required and replacing broken terminal lids.

(7) Inspection of terminals for broken lugs.

(8) Placing grade clamps to prevent creeping of cable.

(9) Reporting all cable openings found, together with location so these may be checked against office files.

(10) Making reports of all hazardous conditions.—Archie Sutherland in Indiana Telephone News.

UNIQUE FURNACES

Gasoline—Kerosene

PATENTED ARRANGEMENT FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
AUTOMATIC PUMP INSIDE TANK
16 GUAGE STEEL TANK WELDED BOTTOM

50 pounds of solder melted in **10 minutes.**

But, more important

The length of time they will remain in the field free from trouble common to the average furnace will surprise the most experienced user.

We'll name public utilities with over **1000** UNIQUE furnaces in use. May we send proof?

UNIQUE MFG. CO., Inc.

221 Whiting St. Chicago, Ill.

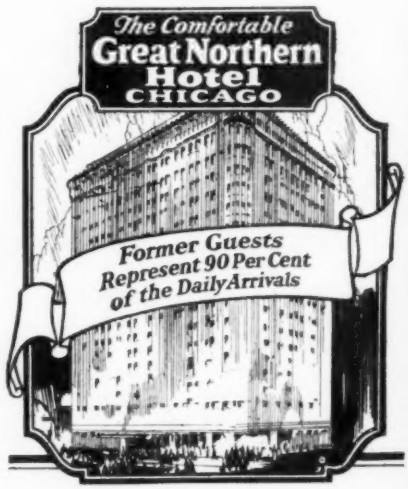
RECONSTRUCTED EQUIPMENT

Western Elec. No. 250 or 229 type Transmitters complete @	$ 1.15
Western Elec. No. 329 type Transmitters complete @	1.40
Western Elec. No. 122 external post Receivers with cord @ $1.00—No. 143 type @	1.40
Magnet Charger for recharging Generator, ringer & Rec. magnets, works off 6-volt Ford Auto Batt. @	8.00
Dean Elec. or Garford C. B. Steel hotel sets equipped with balance coil talking Ckt. and Straight line or 16-33-50 or 66 cycle harmonic ringers @	5.00
Western Electric Co. No. 533 Common Batt. steel hotel sets with enclosed gongs, Straight line @	7.50
Kellogg or Western Elec. No. 13 Local Batt. Ind. coils @	.35
Western Elec. No. 20 Common Battery Ind. coils @	.35
Kellogg No. 2696 type 3-bar 1000 or 1600 ohm Bdg. compacts @ $7.75—4-bar @	8.50
No. 19 single conductor inside telephone wire, per 1000 feet @	3.75
4-foot 3-conductor New desk set cords, brown finish @	.15
Stromberg No. 14 or Dean Elec. Receivers complete with cords @	1.10
Kellogg 16-33-50 or 66 cycle harmonic ringers @	1.25
Kellogg No. 28 3-bar 1000 or 1600 ohm Bdg. desk set with external post signal cases @ $9.50—with concealed cord and line signal set @	10.00

Write for Our Bulletin

REBUILT ELECTRIC EQUIPMENT CO. Not Inc.

1940 W. 21st St., Chicago



TRAVELERS select the Great Northern for its wonderful location in Chicago's "loop". They return because the large comfortable rooms, homelike environment, attentive service, excellent food and moderate charges make it an ideal hotel.

400 Newly Furnished Rooms
$2.50 a day and up

Sample Rooms
$4.00, $5.00, $6.00
$7.00 and $8.00

WALTER CRAIGHEAD
Manager

Dearborn St. from Jackson to Quincy
New Garage One-Half Block

Texas Association to Hold District Meetings

The Texas Independent Telephone Association has announced district meetings as follows:

Sherman, July 19 and 20.

Tyler, September 19 and 20.

San Angelo, November 21 and 22.

Other meetings will be held during the year. Texas usually holds five to six district meetings, which are well attended.

Jas. R. Kearney Corporation Announces Reduction in Prices

The James R. Kearney Corporation, 4224-32 Clayton Avenue, St. Louis, Mo., manufacturers of Overhead and Underground Utility Equipment, announce a price reduction on solderless service connectors effective May 1, 1928, and guy wire clips effective May 25, 1928. We also announce the manufacturing and marketing of Kearney Hi-Tension 4-in-1 Expansion Anchors, four sizes. Prices on these anchors are effective May 25, 1928. Bulletins covering these three products are available and will be sent upon request.

Bell Company Buys Small Holdings in Montana and New Mexico

The Mountain States Telephone and Telegraph company has given notice of its intention of acquiring the Roy Telephone company, Roy, N. M. Roy is a small exchange serving less than 100 patrons.

The same company plans to take over the properties of Otto Schulz of White Sulphur Springs, Montana, consisting of two exchanges, one at that place and the other at Wilsall, Montana. The two exchanges serve some 230 patrons.

ANALYST, ACCOUNTANT, CONSULTANT

To Independent Telephone Companies interested in getting a fair and equitable division of toll revenues.

Your inquiries will be given prompt attention.

ERNEST J. MENDEL
P. O. Box 128
Fort Smith, Arkansas

J.K. Johnston, Telephone Engineer

During recent years I have been privileged to appraise Telephone Exchanges all over the United States. The list totals 663. Would you like to avail yourself of my services?

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613 Merchants Bank Bldg. Indianapolis, Ind
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Specialization on Public Utility Accounting Records and Audits enables us to best serve Telephone Companies.
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1014 Merchants Bank Bldg., Indianapolis, Ind

Phone Adams 5646

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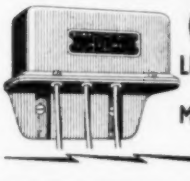
COLUMBUS, O.

Make Use of Our Combined Century of Engineering Experience

FOR SALE

Western Electric No. 20 C. B. induction coils	$ .30
New Kellogg 12 volt switchboard lamps, per 100	10.00
New 2 conductor black silk desk stand cords	.20
No. 17 parallel bronze drop wire, 1,000 feet	6.50
Used copper clad twisted pair drop wire, per ton	25.00
2 groove knobs, per 1,000	10.00
4 groove, per 1,000	20.00

TELEPHONE REPAIR SHOP
6966 Ravenswood Avenue
Chicago, Illinois



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OPERATORS' BREAST PLATE SETS

S. C. white enameled breast plate operator's sets complete	$5.00
S. C. No. 23 plugs for same	.35
New mouthpieces for same	.50
S. C. No. 20 operators' receivers and head band	2.00
Kellogg S. and S. Co. No. 1076 operators' breast plate sets complete	5.00
S. C. and Kellogg jacks for above sets	.35

BUCKEYE TELEPHONE and SUPPLY CO.
COLUMBUS, OHIO

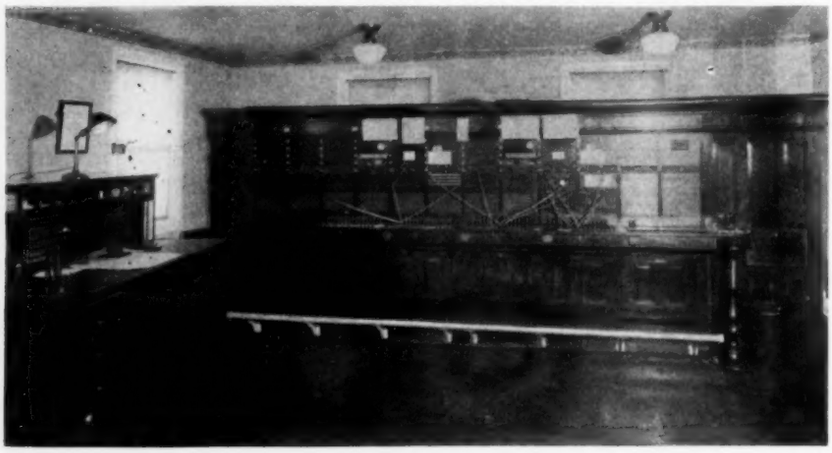
The Passing of the "Crank"

For forty years the people of Ephrata and Lititz, Pa., have had to turn the crank to get central. Times have changed and now these two rapid growing boroughs are enjoying fast common battery service.

On June 1, 1927, work was started on the installation of a new Kellogg six-position multiple switchboard equipped with 460 common battery lines, 60 rural lines and 40 trunk lines. This switchboard was put into service November 26, 1927, much to the enjoyment of the Denver and Ephrata Telephone and Telegraph Company's subscribers. The new plant will take care of all telephone growth in Ephrata borough and surrounding territory for a number of years. The ringing is of semi-selective type in the borough and open ringing on rural lines. The selective ringing in the borough will not be used until all of the new common battery telephones have been installed.

Kellogg Multiple Common Battery Installed at Ephrata, Pa.

The unsightliness of telephone poles in the vicinity of the telephone exchange has been done away with. All incoming lines are run through underground cables. This has proven very economical as the damage generally caused by storms is eliminated.



Kellogg Multiple Common Battery Switchboard Installed at Lititz, Pa.

A six-position Kellogg common battery multiple switchboard of the same size and capacity as that used at Ephrata was installed at Lititz last year. Due to the better telephone service the telephone company has experienced a big increase in subscribers.

The history of the Denver and Ephrata Telephone and Telegraph Company has been one of progress. On May 11, 1911, a charter was granted to the Denver and Ephrata Telephone Company which was organized by local people. That the people of Ephrata are still backing their telephone company is shown by the fact that they boast two hundred and seventy stockholders.

The first switchboard installed at Ephrata was of the single position type with fifty lines equipped. One year later it was necessary to put in a two-position switchboard which took care of the business until 1924. At that time another position was added, and in 1926 the fourth position was installed. These boards soon were filled to capacity and in 1927 the new common battery switchboard was purchased.

The borough of Lititz has experienced an equally colorful growth. A two-hundred line Kellogg magneto switchboard was installed in 1915 and additions were made gradually until 1927, when the new Kellogg multiple switchboard was installed in their new home located at 104 East Main street, Lititz, Pa.

The properties are ably managed by Mr. C. E. Eaby, president and general manager. The board of directors consists of W. F. Brossman, C. E. Eaby, D. W. Buch, D. W. Artz, Bertha M. Brossman, Monroe Lausch and J. E. Nissley.

COMING CONVENTIONS

Pennsylvania, Erie—August 8-9-19.
U. S. Ind. Telo. Assn., Chicago—October 16-17-18-19.

Officers and Directors of the Denver & Ephrata Telephone Co.: Standing from left to right, they are—J. C. Missley, Bertha Brossman and Monroe Lauscsh. Seated from left to right, they are—D. W. Artz, D. W. Buch, C. E. Eaby and W. F. Brossman.